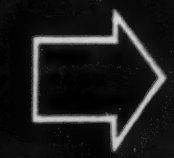
HAZARDS

STATIC ELECTRICITY



CB&I CRAFTSMANSHIP IN STEEL

...the product of Engineering with Imagination

This unique vacuum tower was fabricated and erected by CB&I to meet an exacting set of performance requirements at the El Paso refinery of Standard Oil of Texas:

FEED: 13,000 barrels per day, reduced crude

NOMINAL PRESSURE: 2 pounds per square inch, absolute

OPERATING TEMP: 750 degrees Fahrenheit (approx.)

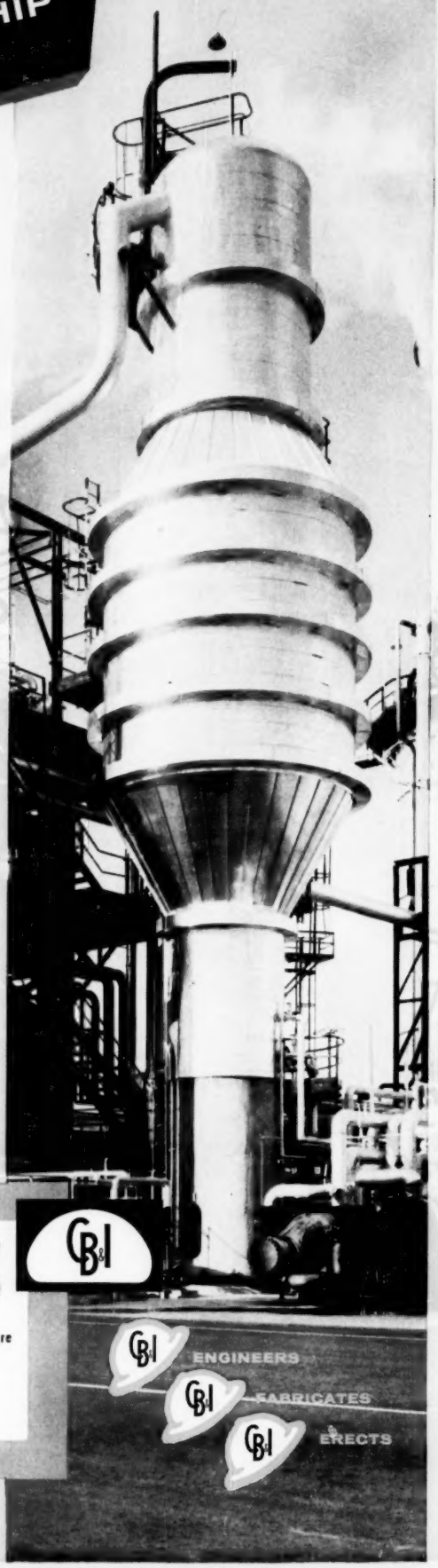
HEIGHT: 87 feet

DIAMETER: Varies from 8 to 18 feet

What is CB&I *Craftsmanship in Steel?* This unusual structure is a good example. It is engineering tempered with imagination. It is close attention to metallurgical control and structural detail. It is careful customizing of structure to process. Most important, it is *experienced coordination* through *all* phases of engineering, fabrication and erection.

These *coordinated services* are the reason why leading refiners rely again and again on CB&I for their critical tanks, towers and processing structures. For more information, write your nearest CB&I office, today. Ask for the brochure: *CB&I Craftsmanship in Steel.*

CB&I-built vacuum tower designed for reduced crude feed of 13,000 bpd. CB&I also built a reactor and regenerator, furnished through Fluor Corporation, Limited, for Standard Oil of Texas.



Chicago Bridge & Iron Company

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SUBSIDIARIES:
Horton Steel Works Limited, Toronto; Chicago Bridge & Iron Company Ltd., Caracas; Chicago Bridge Limited, London; Chicago Bridge Construcoes Ltda., Rio de Janeiro

REPRESENTATIVES AND LICENSEES:
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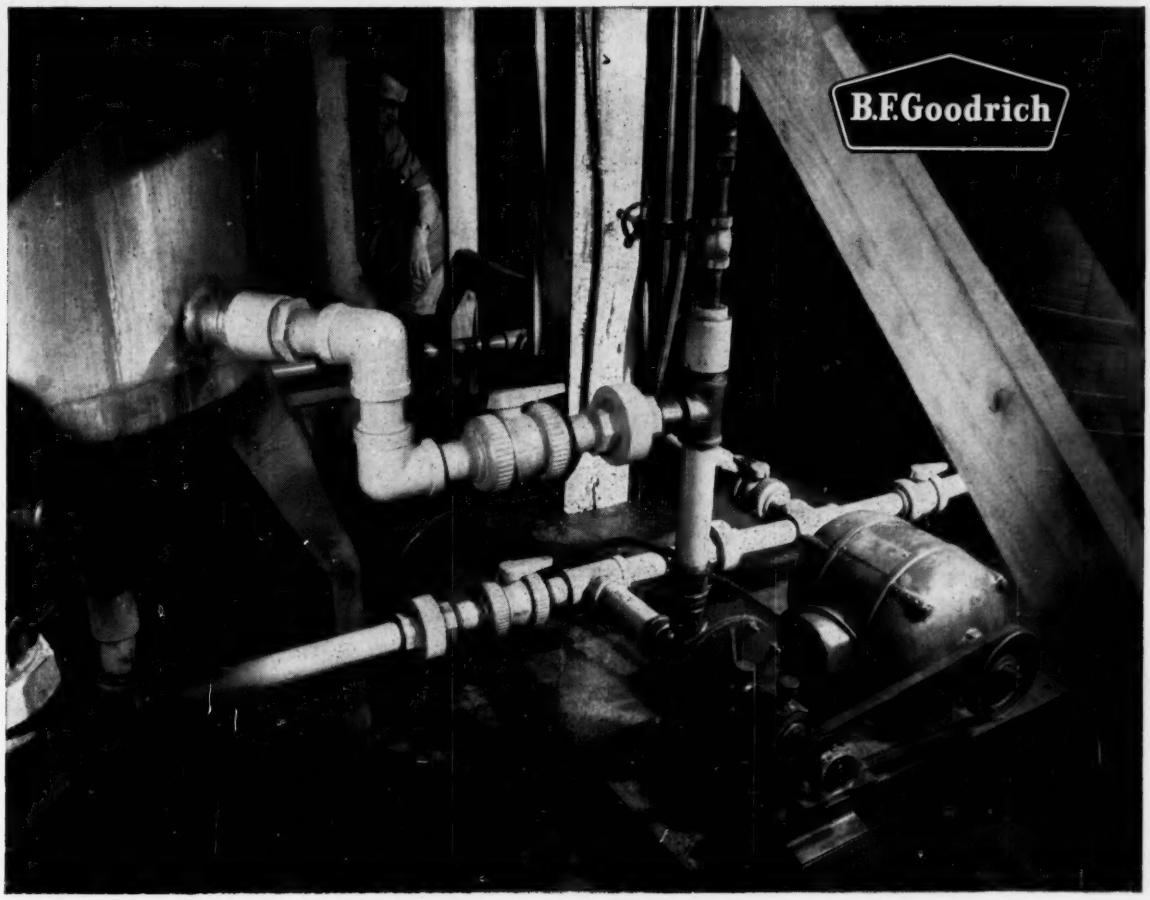
P84CB



Fruit juices stay pure flowing through B.F.Goodrich Koroseal PVC pipe

WAYNE PACKING COMPANY, frozen fruit packers, Sodus, New York, expanded early in 1958. Pipe, fittings and valves for new juice handling operations had to meet several requirements . . . (1) resistance to citric acid corrosion; (2) original installation economy; (3) durability, to keep maintenance expense and downtime to a minimum; and (4) most important, they had to be nontoxic to avoid product contamination.

B.F.Goodrich Koroseal PVC pipe and fittings were installed to carry apple, cherry, grape and strawberry juices ranging from single strength to 72 Brix concentrates. Job conditions include temperatures up to 140°F, high humidity, steam vapors and around-the-clock service.

After more than a year's service, Mr. R. S. Chittenden, owner of Wayne Packing, reports, "Koroseal has answered our problems 100%! Not only was this installation economical, but we achieved the durability and sanitation that was so necessary. Our production line runs 24 hours a day, and I'm happy to report not one interruption due to pipe or fitting failure."

In addition to its economy and nontoxic qualities, Koroseal PVC pipe offers superior resistance to corrosion, high impact resistance and excellent insulation properties. It threads easily, can be cut, welded or drilled. It never needs to be painted, will not support combustion. Koroseal is available in pipe, tubes, rods, valves and sheets.

Perhaps Koroseal can solve your problem! *For more detailed information about the advantages of Koroseal, just mail the coupon below.*

B.F.Goodrich Industrial Products Co.
Dept. CE-6, Marietta, Ohio

Please send me free booklets on:

☐ Rigid Koroseal Pipe
☐ Rigid Koroseal Sheet

Name_____

Company_____

City_____ Zone____ State_____

Koroseal—T. M. Reg. U. S. Pat. Off.

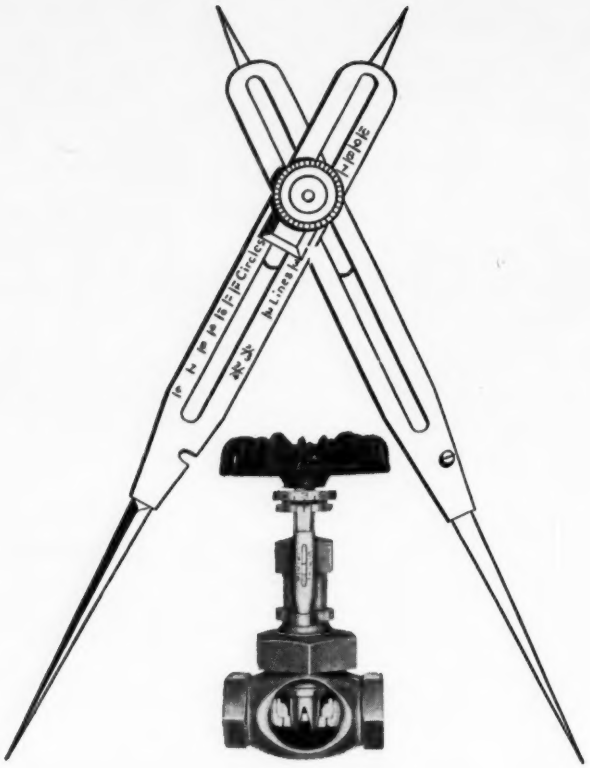
B.F.Goodrich *Koroseal rigid PVC products*

June 1, 1959 **Chemical Engineering** Vol. 66 No. 11

CHEMICAL TECHNOLOGY FOR PROFIT-MINDED ENGINEERS

* FREE—for your files—Check Reader Service postcard (p. 177) for an extra file copy of this guide to faster answers to your fluid-flow problems.

Contents continued . . . turn page



PROPORTIONER

controls flow to save for you

The V-port disc in all Hancock "Flocontrol" Valves insures proportional flow throughout the entire lift of the stem. They are valves that help you achieve uniform product quality through closer control, save steam and fuel on process work, and cut maintenance costs.

"3 in 1" valve design combines variable orifice with shut-off and micrometer dial and pointer. The valve opening can be set within 1/10 turn of the handwheel —you can duplicate all settings easily, instantly. No shut-off valve required—flow is in a straight line, with separate shut-off seating surface located away from the V-ports.

Hancock "Flocontrol" Valves are available in Bronze and Steel to meet the most demanding services. Ask your industrial supply distributor for details.

Hancock "Flocontrol" valves assure positive pinpoint control—eliminate all guesswork.

MANNING MAXWELL & MOORE INC. TRADE MARK

HANCOCK "FLOCONTROL" VALVES

A product of

MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Watertown, Massachusetts

In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

Contents, continued

Chemical Engineering

June 1, 1959

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Steam trap dependability is a matter of what the manufacturer puts into the trap

ARMSTRONG TRAPS ARE DESIGNED AND MADE TO GIVE YOU DEPENDABILITY

1. Efficient, proved operating principle

Armstrong Traps provide the most advanced development of the time-proven inverted bucket principle. Simple, but effective, there isn't much that can go wrong.

2. Good design

Armstrong Trap design gives big capacity in a small package. The mechanism is virtually fool-proof. All body styles are easy to inspect and maintain without removal from the line.

3. Highest quality materials of construction

Only the best goes into Armstrong Traps. Bodies are close grained 30,000 tensile iron castings or high quality forgings. Working parts are all tough, corrosion resistant stainless steel.

4. Good workmanship

Armstrong Traps are made by craftsmen who take pride in their work. Careful inspection and frequent checking insure the quality of the trap.

5. Application know-how

Your problem has probably been solved already in the extensive experience of the Armstrong engineering and sales organization. You can be sure of sound, dependable recommendations.

Your local Armstrong Representative can show you what Armstrong dependability can do for you. Call him today or write direct.

860 Series for low pressure heating service.

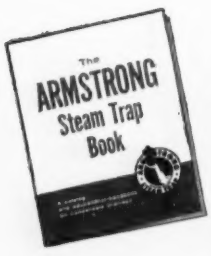
800 Series, side inlet, side outlet.

No. 801, side inlet, bottom outlet.

880 Series, integral strainer.

200 Series, bottom inlet, top outlet.

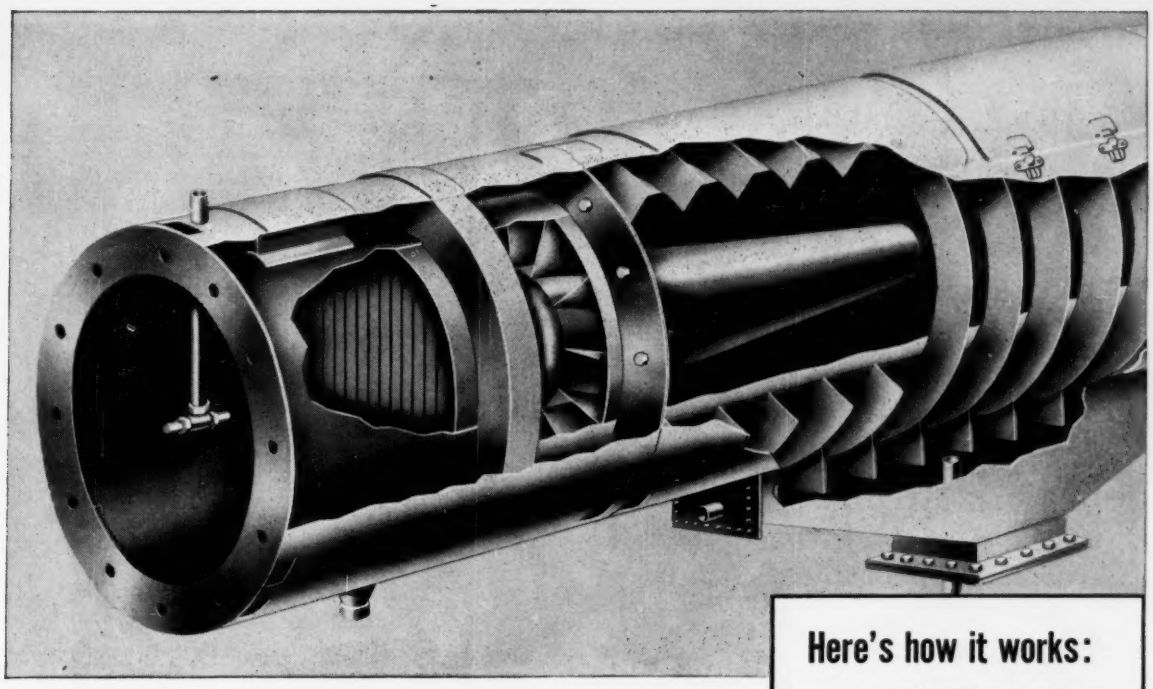
Forged Steel Series for high pressures, high temperatures.



The 48 page Armstrong Steam Trap Book tells how to correctly size, install and maintain steam traps for any pressure, any temperature, any load plus full catalog data on Armstrong Steam Traps. Ask for Catalog K.

ARMSTRONG MACHINE WORKS

8586 Maple Street Three Rivers, Michigan



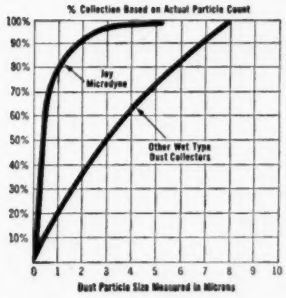
Here's how it works:

a spray of liquid enters the collector along with the dust. An impingement screen helps to encase each particle with liquid. Then fixed vanes impart a whirling motion to the wet, dust laden air. Moisture and dust particles are thrown to the sides by centrifugal force and drain into a sump.

The liquid used may be water, oil or solvents, depending on the material being collected.

JOY MICRODYNE®

DUST COLLECTOR PACKS MORE EFFICIENCY IN 1/10 THE SPACE



By combining two proved principles of dust collection, the Joy Microdyne collects over 99% by weight of dust particles 5 microns and larger; 92% of 2-micron dust. This means cleaner air.

Because of its unique design the Joy Microdyne is extremely compact . . . 1/10 to 1/20 the size of conventional wet collectors. For example: an 8000 cfm unit is only 26″ in diameter, 130″ long. This means lower initial cost and easier installation . . . in fact, the Joy Microdyne can be installed as part of existing ductwork.

Let us know about your dust collecting problems by describing the type of dust, approximate particle size and cfm required—and write for free bulletin 317-11.

AIR MOVING EQUIPMENT FOR ALL INDUSTRY

JOY

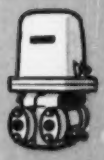
Joy Manufacturing Company
Oliver Building, Pittsburgh 22, Pa.

In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario

WSW 17570-317

Indicating Motion-Type Transmitters

... for flow, pressure, and level



Low Displacement Force-Balance Transmitters

...for flow, pressure, and level

Thermocouple and Resistance Bulb Converters

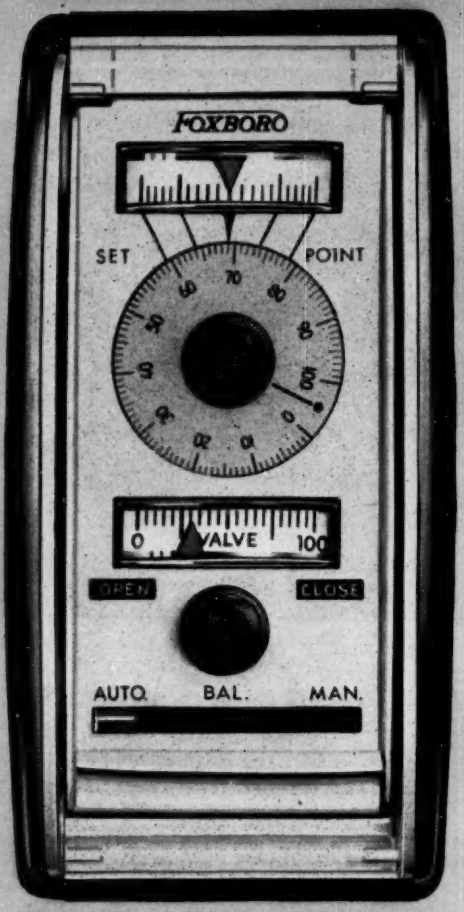
... magnetic amplifiers... no vibrators
... no mechanical rebalancing

Displacer Level Transmitters

...force-balance for simplicity

Control Valves

... electro-pneumatic and electro-hydraulic actuators

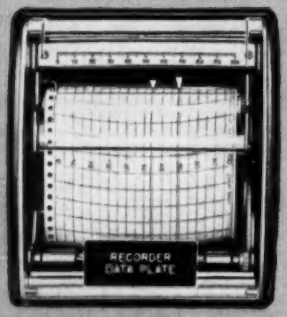


CONTROLLER

The Electronic Consotrol Controller (shown 4/5 actual size) concentrates all control and supervisory functions in one slim 3 x 6 inch case. Controller operation is entirely independent of recorder.

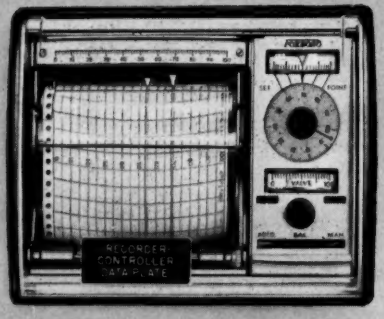
FOXBORO Electronic

REG. U.S. PAT. OFF.



RECORDER

Electronic Consotrol Recorders (shown ¼ actual size) use a simple, powerful pen motor which can be operated directly from transmitter signal without amplification. Available in 1 and 2 pen models.



COMBINED RECORDER-CONTROLLER

Electronic Consotrol housing design permits unequalled flexibility in panel arrangement. Recorders and controllers can be mounted separately in individual housings—or enclosed in a compound unit. Regardless of mounting, either unit pulls out independently.

for the first time... the 100% solid state electronic system!

- thermocouple and resistance bulb converters-using magnetic amplifiers
- choice of force-balance and motion-type transmitters
- long time-constant tubeless controllers

Consotrol Instrumentation

Electronic Consotrol* Instrumentation—the most complete and advanced family of electronic-operated measurement and control instruments available today! That just begins to describe Foxboro's dramatic new advance in instrumentation. ✓ ✓ ✓ Foxboro electronic transmitters, indicators, recorders, control stations, computing stations, valve actuators and other final operators cover every function in the control loop. All are linked by a d-c current signal. All are completely tubeless. Even thermocouple and resistance-type systems no longer require vacuum tubes. ✓ ✓ ✓ Electronic Consotrol systems convert temperature, pressure, flow, level, and other measurements, to a proportional signal **at the transmitter.** Transmission to a remote control station is instantaneous. Designs are available for both hazardous and non-hazardous areas. ✓ ✓ ✓ Electronic Consotrol Instrumentation heralds a whole new era in process control engineering. Write Foxboro today for the new 32-page Catalog 21-10 which gives full details. **The Foxboro Company, 366 Neponset Ave., Foxboro, Mass., U.S.A.**

*Reg. U.S. Pat. Off.

Fred Wheelwright, Manager, Industrial Sales:

"The profit derived from a process is directly dependent on the efficiency of the processing equipment. Here, at De Laval, we specialize in bringing maximum efficiency to the chemical processor.

"We go at it with a triple punch: an outstanding engineering staff; the most complete processing pilot plant in the country; and a full line of efficiency-engineered process equipment.

"The case of the detergent manufacturer cited in this advertisement is an example of our work in helping processors develop profitable processing operations. Without the specified, high efficiency centrifuge, this process might well have proved impractical because of the production costs.

"Why not let us devote our facilities and engineering talent to *your* problems. Just drop us a line on your letterhead describing your process. We'll be glad to recommend ways to increase your processing efficiencies. And, of course, there is no obligation to you."

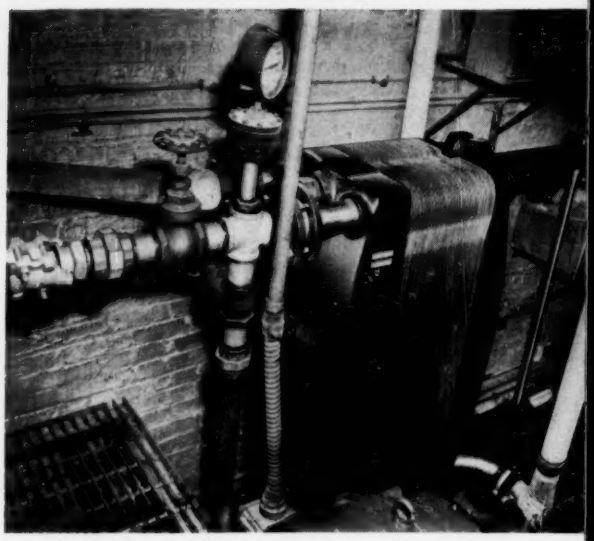
For further information, write to De Laval.

DE LAVAL

Dept. C-5

THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York
5724 N. Pulaski, Chicago 46, Illinois

DE LAVAL PACIFIC COMPANY
201 E. Millbrae Avenue, Millbrae, California



THREE SOLVED WITH

TDM* classification of silica increased plant production 100%

Problem: To accurately classify five grades of silica as the last processing step before packaging and warehousing. Bottlenecking at this point had cut plant production.

Solution: A system of De Laval Syncro-Matic Separators with TDM Control. On leaving the dryer, silica was fed to the Primary screening unit which handled 11.3 tons per hour at efficiencies of better than 95%. The Secondary screener picked up the balance of the silica, handling 4 tons per hour, also at efficiencies of better than 95% on each grade.

By using De Laval Syncro-Matic Separators with TDM Control in this application, plant production was increased a full 100%.

*T D M . . . *three directional motion control.* The Syncro-Matic has motion controlled in all three directions . . . horizontal, vertical and gyratory. It's the secret of the unit's outstanding efficiencies, and it is also responsible for the far greater throughput possible with the machine.

Available in carbon or stainless steel, the Syncro-Matic may be obtained with from one to three decks, and a full range of screen meshes and materials. Operation of the unit is exceptionally quiet.

For further information about this versatile new screen separator, just drop us a line on your letterhead. No obligation, of course.

Downtime for cleaning cut over-all efficiencies in Shell & Tube shellac cooling

In refining shellac to remove wax (a valuable by-product), the solution of shellac and soda ash must be heated to 200°F. After the wax is removed, the solution must be cooled rapidly. The processor had been using a Shell & Tube exchanger, but down-time for cleaning, and a series of cloggings and leakages had made serious cuts in processing efficiency.

Problem: To cool 13,500 lbs. per hour of the shellac/soda ash solution from 200°F. to 70°F. The efficiency of the operation is of prime importance because the processor does not have an abundant water supply.

Solution: A single section De Laval P-12 Plate Heat Exchanger. The unit requires only 12,600 lbs. per hour of 60°F. water and maintains a temperature differential of 10°F. The plate heat exchanger cools the shellac/soda ash solution both rapidly and with the most efficient use of the available water supply.

The ease of cleaning the De Laval Plate Heat Exchanger is important to the processor, too. The plate pack is easily opened, immediately exposing all heat transfer surfaces for thorough, rapid, manual cleaning. Constructed of stainless steel throughout, it is easier to clean and eliminates problems of contamination in operation.

Note in the illustration how compact the unit is. It easily fits into available plant space, required no additional construction. And since this unit has been installed, the processor reports complete elimination of problems due to clogging or leakage.

If your process could benefit from the top efficiencies, maximum temperature control, and higher capacities of the De Laval Plate Heat Exchanger, why not drop us a line requesting more information? There's no obligation to you, and it may well prove the answer to some of your processing problems.

EFFICIENCY PROBLEMS... DE LAVAL PROCESS EQUIPMENT

CENTRIFUGES • PLATE HEAT EXCHANGERS • VIBRATING SCREENS • COMPLETE PROCESSES

Processor of new detergent cleaned up recovery problem with fast, non-stop separator

Problem: A processor developing a new detergent made from vegetable oil needed an efficient method of recovering the expensive catalyst in re-usable form. Previous attempts had recovered non-dispersible catalyst in a hard cake form.

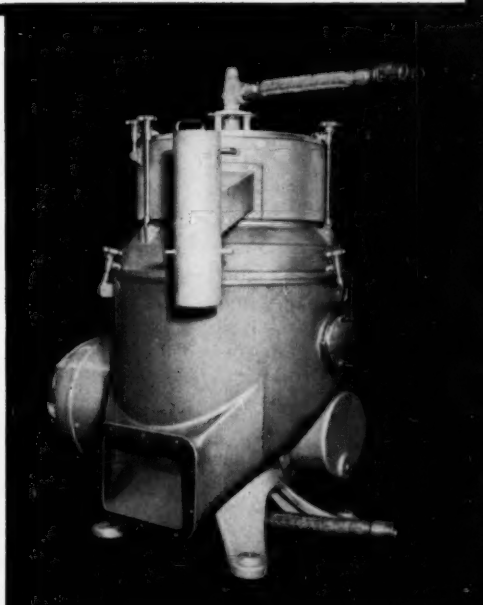
Solution: A De Laval AC-VO "Nozzle-Matic" Centrifuge. Since the heavy phase in the separation (containing the catalyst) is thrown to the bowl wall and discharged *continuously* as part of the machine's normal operation, the catalyst is recovered in a thick slurry. In this form, it is easily re-dispersed.

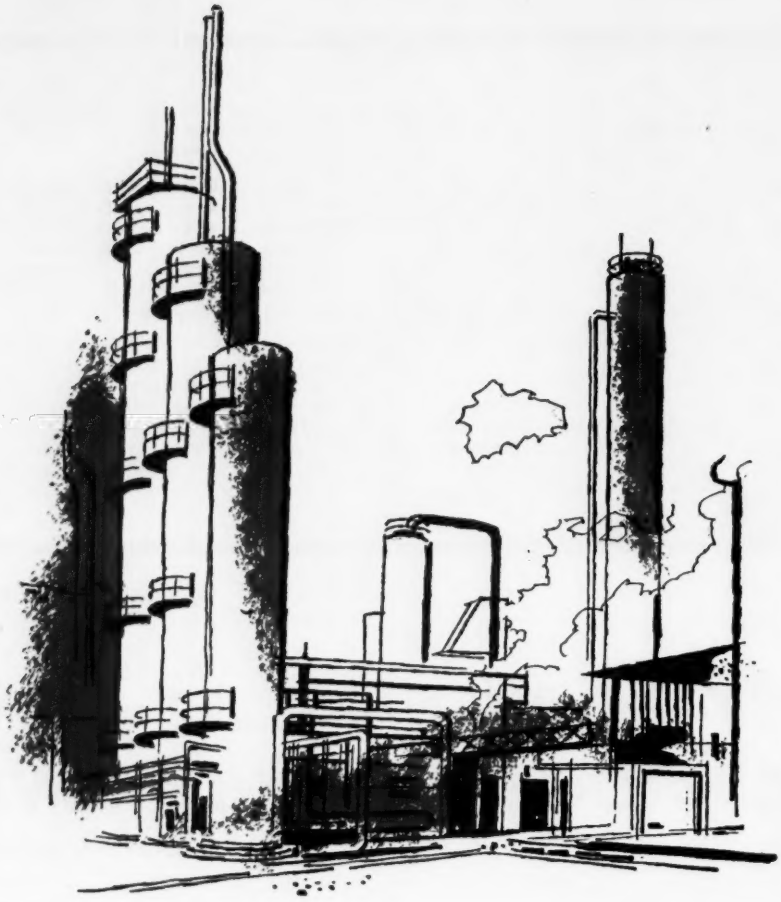
This particular unit was also supplied with a heavy phase recirculation feature. As the heavy phase is discharged through the nozzles built into the bowl wall, it is picked up and recirculated to the centrifuge bowl. The result is a higher concentration of the catalyst, and in a state of maximum clarification.

The higher capacities possible with De Laval continuous discharge centrifuges were important to this processor, too. Combined with the fast operation, they insured maximum catalyst life. Slow operation had been a factor in the hard caking of the catalyst in previous attempts at recovery.

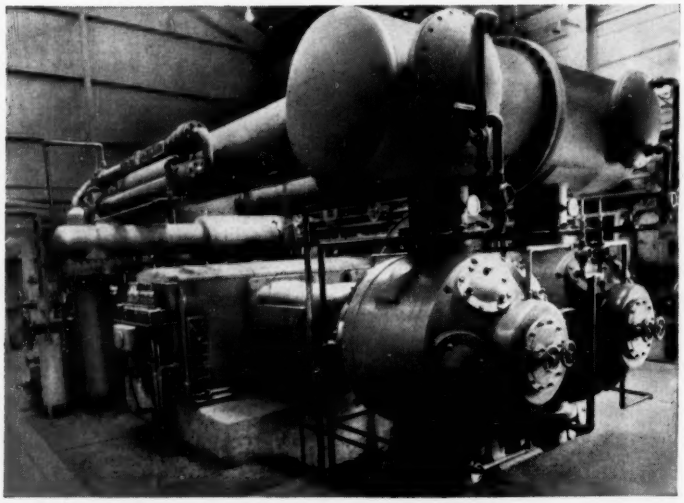
Wherever recovery of a solid is important in your process, you should consider the different types of solids concentrators we make at De Laval. There is a type for every recovery operation.

Why not drop us a line for further information? Just tell us the type of recovery which interests you. There is no obligation, of course.

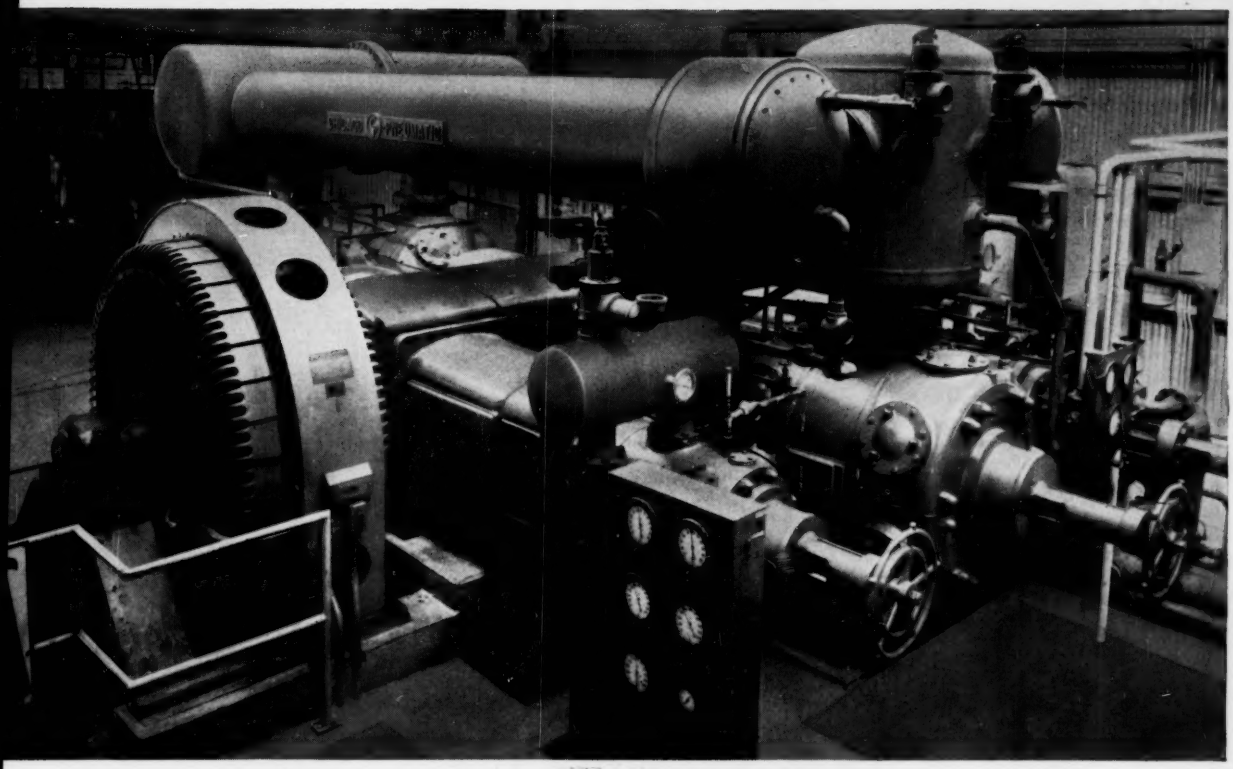




CLASS WORKHORSE



Two views of a 2500hp, five-throw, five-stage Class FE Compressor installed in a large steel plant



FE COMPRESSORS FOR AIR LIQUEFACTION

Class FE horizontal, balanced-opposed compressors are doing an impressive job in the production of oxygen and in many other processes which demand compressors that take high pressures and heavy duty service in their stride. The "FE" is only one of many CP designs for such requirements. Horsepowers to 5000; pressures up to 15,000 pounds. Write for detailed specifications.

Chicago Pneumatic 8 East 44th Street, New York 17, N. Y.

AIR AND GAS COMPRESSORS • VACUUM PUMPS • PNEUMATIC TOOLS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS

Looking for cost leaks? Look at your steam traps

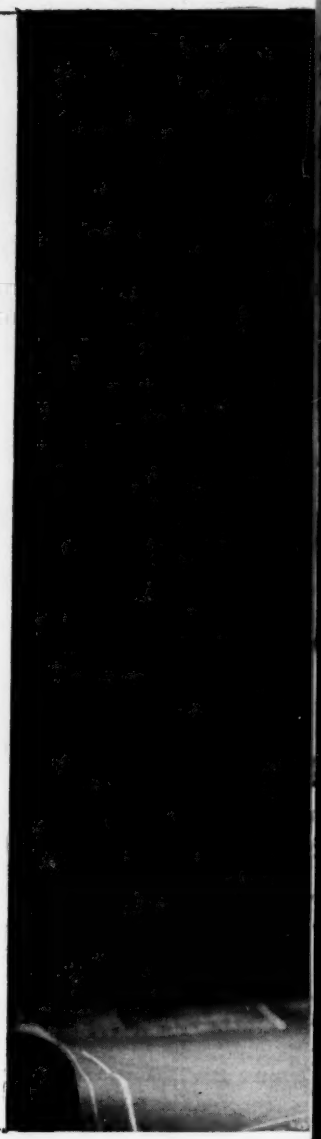
Engineering approach to steam trapping can save thousands a year on costs of fuel, trap maintenance, process cycle time, and uniformity of product quality

Plant and process engineers all across industry have found that Sarco *Production-Planned* steam trapping can pare operating costs by thousands of dollars a year.

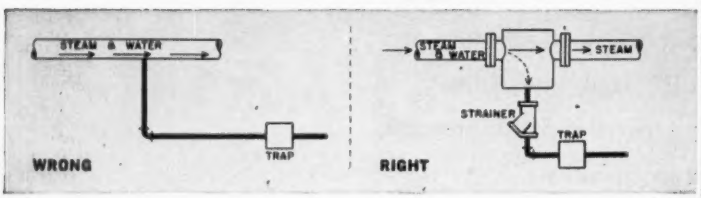
Production-Planned steam trapping is an engineering approach to the problem of getting full design values of heat transfer from steam using equipment. Scores of case histories show that it can make substantial savings and improve processing efficiency. At the same time, costly trap maintenance can be greatly reduced.

In Sarco *Production-Planned* steam trapping, traps are matched to the job by *type* as well as size. They are properly placed, correctly installed. And, to keep down maintenance and replacement costs, every trap is top-quality.

It may pay you well to take this engineer's-eye view of *your* steam trapping. And why not have a Sarco representative look over your system with you? His suggestions will be completely objective because Sarco—and only Sarco—makes a steam trap for every basic requirement. Quality? Recognized everywhere for half a century.



Production-planned systems make best use of traps



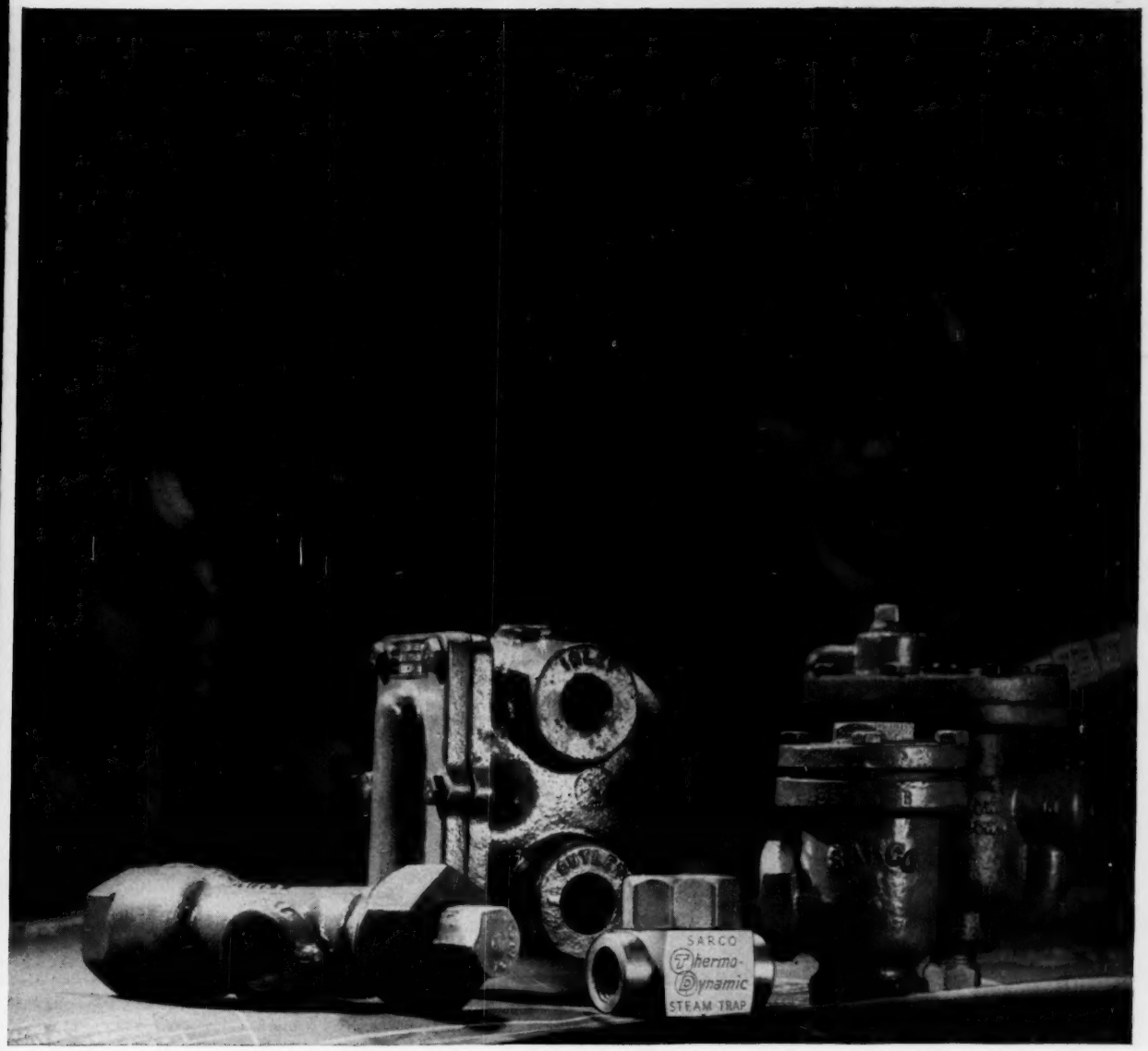
As the two illustrations above show, correct application of steam traps is as necessary as using the right trap. In the hook-up on the left, the lack of a condensate collection point plus the long leg to the trap will result in condensate's flowing past the drain point, possibly causing water hammer. The correct way to install the trap is shown at right, placed close to the drain point. A *strainer* should be placed before *any* trap to prevent entrance of scale or other foreign matter into the trap.

This is just one example of the way your Sarco representative can help you plan your steam system for maximum production.

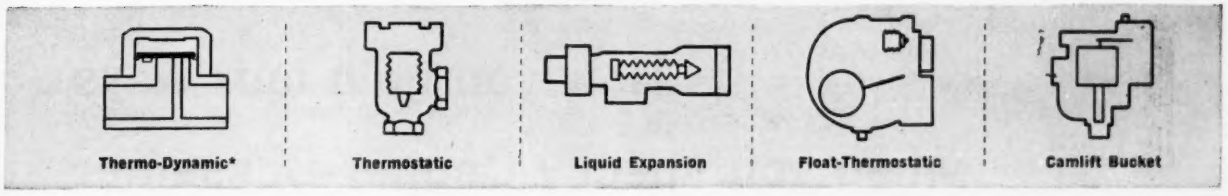
Traps must be matched to job for best system performance

No single type of steam trap will perform well in all applications. Each type has a range of applications for which it is best suited. For optimum efficiency these differences must be taken into account; traps must be chosen for their operating principles as well as their size and pressure rating.

Sarco can give you impartial help in selecting traps because only Sarco makes the five basic types. With Sarco, it's simple —one source, one responsibility, for all your trapping needs.



Only Sarco makes these five basic types of steam traps



5579

Take these two steps to Production-Planned steam trapping:

(1) Write today for Sarco literature; (2) Talk with your Sarco representative. He can help you check your trapping requirements, and he has—or will quickly get—the right answer to any unusual trapping problem.

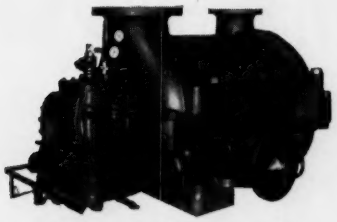
*T.M.U. Pat. No. 2,817,353.

SARCO
COMPANY, INC.
635 Madison Ave., New York 22, N. Y.

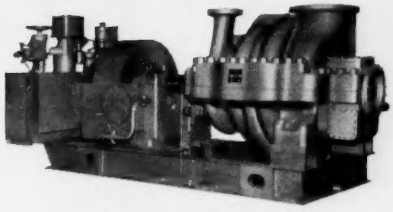
STEAM TRAPPING • AIR VENTING • TEMPERATURE CONTROLS • HEATING SPECIALTIES

John L. Parris, *Manager Centrifugal Compressor Sales, The Cooper-Bessemer Corporation, explains...*

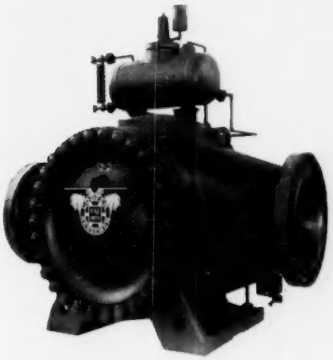
How you gain four ways when you specify Cooper-Bessemer Centrifugal Compressors



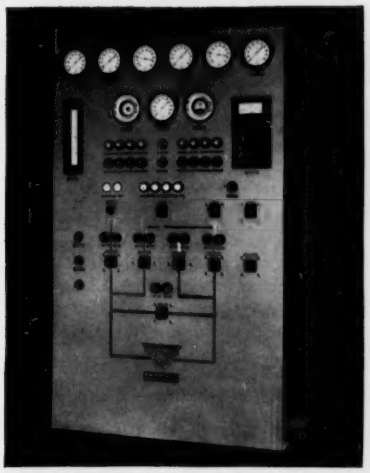
Horizontally split, process air or gas centrifugal compressor. Range: Up to 100,000 cfm.



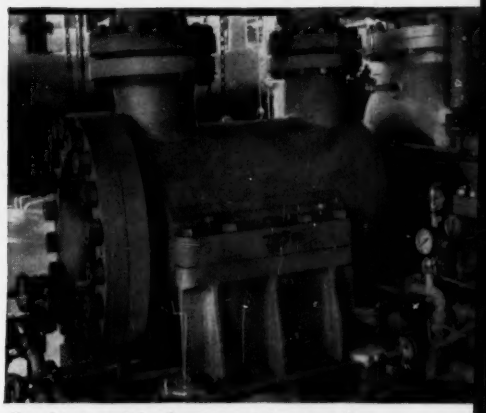
Horizontally split, intercooled centrifugal compressor designed for low cost shop and process air and gas. Up to 30,000 cfm.



Pipeline centrifugal booster with a history of record-breaking performance. Up to 20,000 bhp.



Installations can be integrated with Cooper-Bessemer En-Tronic Controls all the way from simple monitoring to complete system automation.



Barrel type centrifugal compressor for gas and air at pressures up to 5000 psi.

To get the most for your compressor dollars, it will pay you to check into Cooper-Bessemer Centrifugal Compressors because these fully-proved products offer you a combination of four outstanding advantages:

1. You get a design that's matched to your needs. A wide range of types and sizes of Cooper-Bessemer Centrifugal Compressors are available to assure optimum performance on *your* processing or air supply application.

2. You get unsurpassed quality. The designs include many field-proven distinctive features. Cooper-Bessemer's high standards of materials and craftsmanship are applied to every component of these precision-built units... to assure utmost reliability.

3. You can get undivided responsibility. We can engineer the entire compressor installation, including drive and controls. Cooper-Bessemer En-Tronic Controls are available to provide any degree of automation.

4. You get service for most profitable performance. Our outstanding field service and warehouse facilities assure prompt attention to your operating needs... with resulting reduction in your inventory and downtime.

Our nearest office will gladly supply complete information on Cooper-Bessemer Centrifugal Compressors to meet your needs exactly. Call them today.

BRANCH OFFICES: Grove City • New York • Chicago • Washington San Francisco • Los Angeles • Houston • Dallas • Odessa • Pampa Greggton • Seattle • Tulsa • St. Louis • Kansas City • Minneapolis New Orleans • Shreveport • Casper

SUBSIDIARIES: Cooper-Bessemer of Canada, Ltd.... Edmonton • Calgary Toronto • Halifax

Cooper-Bessemer International Corporation ... New York • Caracas Mexico City

C-B Southern, Inc.... Houston

Cooper Bessemer

GENERAL OFFICES: MOUNT VERNON, OHIO

ENGINES: GAS - DIESEL - GAS-DIESEL
COMPRESSORS: RECIPROCATING AND CENTRIFUGAL, ENGINE OR MOTOR DRIVEN

ANNOUNCING NEW **POWELL**

Handwheel Nut—securely holds malleable iron, non-heating handwheel to the stem.

Protruding Packing Gland—a Powell feature—compresses the packing, offers additional guidance to the stem, and prevents packing nut from becoming loose and rotating with stem.

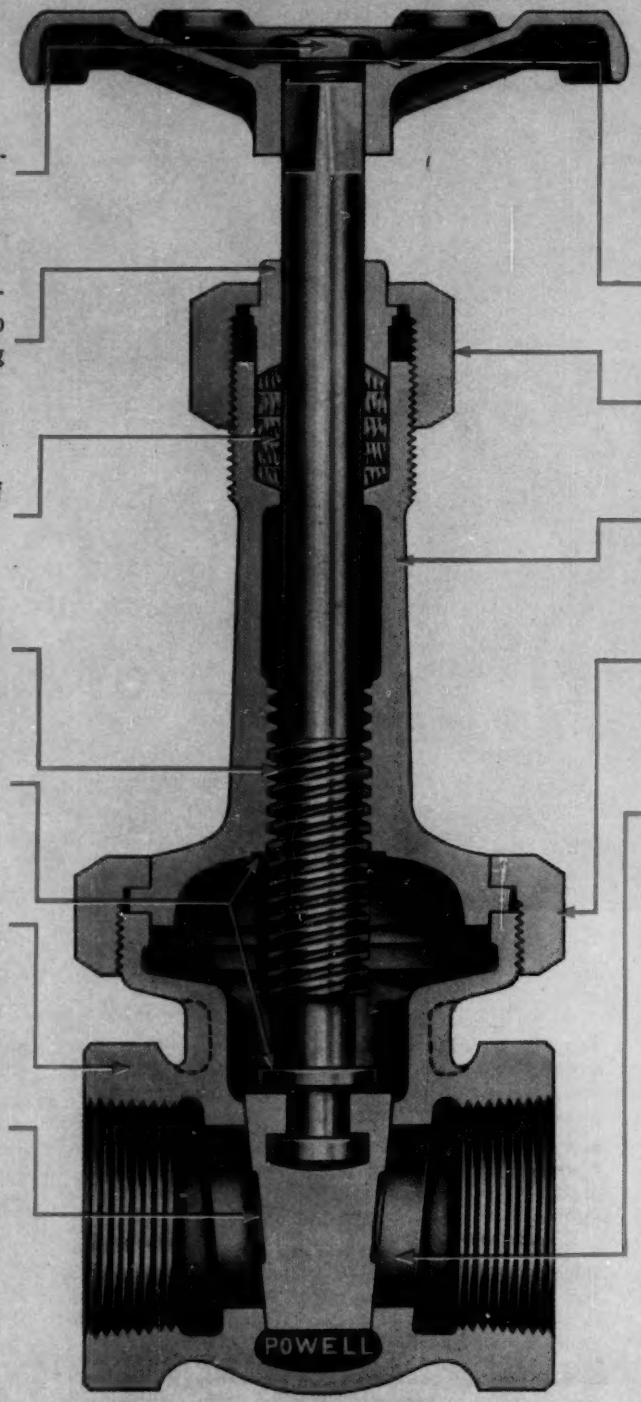
Deep Stuffing Box—holds more than ample amount of high-grade steam packing.

Stem—is high tensile bronze, extra heavy, of large diameter, with long Acme threaded section.

Repack-Under-Pressure Seat and Collar—permit valve to be repacked under pressure when fully open.

Body—a high tensile bronze casting, scientifically designed to provide full flow area through the valve.

Wedges—Interchangeable Solid or Double Wedges are available in rising stem valves. They are held to stem by a "T" slot, and are accurately guided to valve seats by means of integral cast lugs that travel in female guideways in the valve body. Entirely clearing the waterway, full unobstructed flow through is assured.



Sectional—Union Bonnet Rising Stem Gate Valve Fig. 2700—125 pounds, Fig. 2714—150 pounds.

POWELL...world's largest family of valves

BRONZE UNION BONNET GATE VALVES

for 125 and 150 pounds WSP

These new BRONZE Union Bonnet Gate Valves have many superior features—some of which are outlined here. For complete details, write for new illustrated circular. Or check with your nearest Powell Valve distributor.

Identification Plate—gives Figure Number and kind of valve.

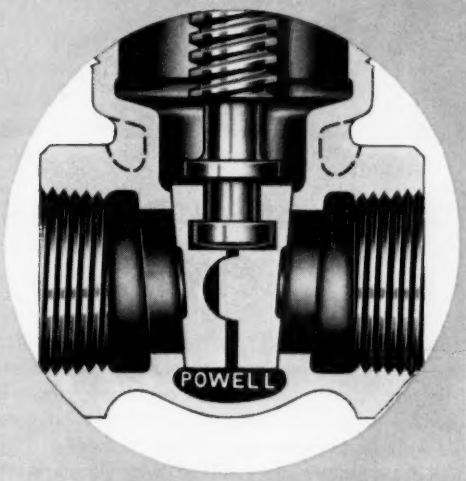
Heavy Hexagonal Packing Nut—for holding gland and adjusting packing.

Long Bonnet—cast of high tensile bronze for long service.

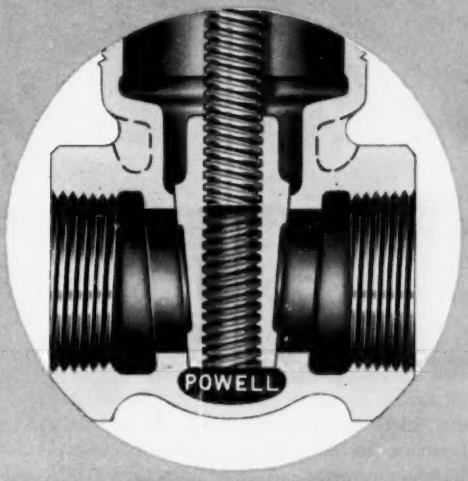
Octagonal Ring Nut—is deep threaded and tightly holds body-bonnet connection. Affords additional wrenching positions.

Ample Space—between seats and end of pipe thread prevents injury to seats when screwing pipe into the body.

Fig. 2707—125-pound Union Bonnet Non-Rising Stem Gate Valve. Also available for 150 pounds—Fig. 2712.



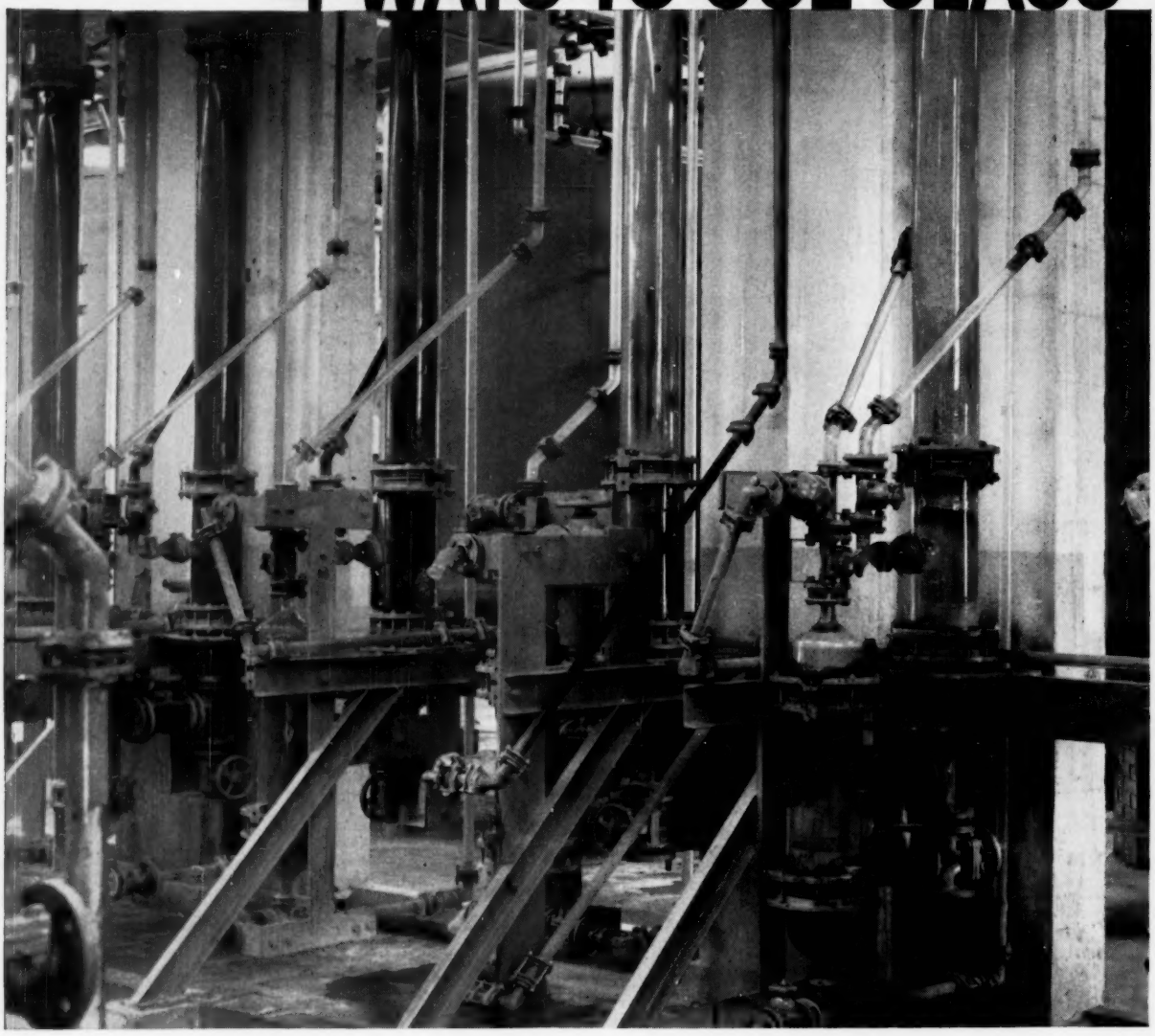
Detail of Sectional View Inside Screw Rising Stem Gate Valve showing Double Wedge Disc and Integral Seats.



Detail of Sectional View Non-Rising Stem Gate Valve showing Solid Wedge Disc that rises on stem. Integral Seats.

THE WM. POWELL COMPANY • *Dependable Valves Since 1846* • **Cincinnati 22, Ohio**

4 WAYS TO USE GLASS



1. Zirconium maker uses 6-inch glass columns to get into commercial production

At the Wah Chang Corporation's Albany, Oregon, plant you'll find an extraction system made up of PYREX brand glass columns, 6 inches in diameter and 50 feet high.

Zirconyl chloride enters the open end against a counter current stream of thiocyanate-rich methylisobutyl ketone. After hafnium is extracted, a countercurrent hydrochloric acid stream strips out any remaining zirconium in three 6-inch by 50-foot glass columns.

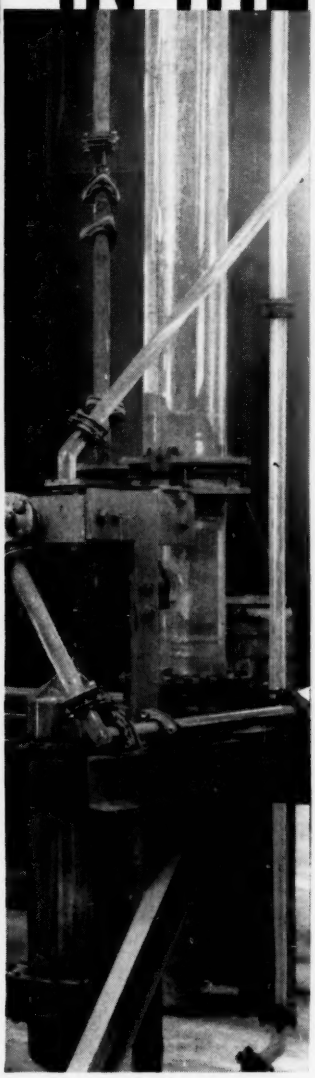
Finally, zirconium-free hafnium raffinate is scrubbed with sulphuric acid in more glass columns—6 inches in diameter and 55 feet tall. The scrubbed solvent then is recycled to the extraction columns and the aqueous solution of hafnium sulfate is neutralized with ammonium hydroxide.

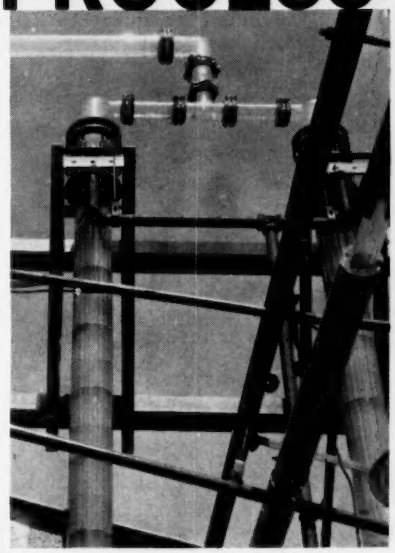
Why PYREX brand glass No. 7740 for this processing? Because this is *the* glass that stands up to corrosive fluids. It is virtually unaffected by most acids or alkalies; there is no side reaction, no pickup. And with PYREX brand glass you have no worries about heat or mechanical shock.

Add up all these factors and you'll see why glass was the choice to help put zirconium into production at a rate of 650,000 pounds per year.

If you would like more facts about PYREX brand glass pipe or columns, use the coupon for getting a copy of PE-3, the complete manual on design, engineering, and installation of PYREX brand glass pipe and fittings.

IN THE PROCESS INDUSTRIES



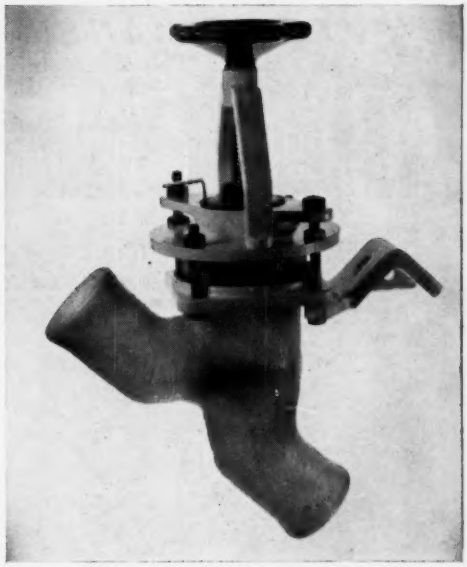


2. Heat, cool, and condense corrosive fluids in PYREX® modular shell and tube heat exchangers

Your liquid will come in contact only with PYREX brand glass No. 7740, plus a chemically resistant ceramic, and TEFLON. You'll have no worry about build-up cutting efficiency, because glass is smooth. You can design systems to use multiple units, in parallel or series-parallel flow combinations. You have low installation costs, because units are light in weight (the 50 sq. ft. capacity model weighs only 165 pounds). Mounting brackets are supplied. You can choose from models that take corrosives on tube side only, or on both tube and shell sides. You owe it to yourself to get the facts today. Use the coupon.

3. No more plug-ups in glass waste-lines handling cellulose acetate dope

Problem: Design a drainline system to handle sulfuric acid, acetic acid, and a cellulose acetate effluent. Complication: when "dope" overflows into the lines, water turns the fluid into a solid acetate flake that tends to plug. The solution: 220 feet of PYREX brand pipe. No problem with corrosion. No worry about shock from steam cleaning. And if dope does build up, it's *visible*. You take down only those sections you need, saving a great deal of time and effort. And you discover that the visibility and ease of cleaning of *glass* make it possible to use smaller diameter lines than with metal. Glass is the practical, modern way to handle wastes, particularly corrosive ones. Put all the details where you can use them—in your hands. Get PE-30.



4. NEW PYREX brand Y-valve

Now you can get a Y-valve for handling most fluids without corrosion or contamination. The valve comes in 1½" and 2" sizes—with 1" to be available soon. You get a tight seal, because a spring-loaded plug keeps TEFLON firmly against the seal. You can disassemble without removing the valve from the line. And you get extra strength, because the body is tempered, then armored with FIBERGLAS impregnated with a polyester resin. Use this valve to 50 psi, up to 250° F indoors, 175° F outdoors, with temperature differentials as high as 200° F. New Bulletin PE-4 gives details.

CORNING MEANS RESEARCH IN GLASS

CORNING GLASS WORKS

1 Crystal Street **Corning, N. Y.**

Please send me:

- ☐ Bulletin PE-3 on PYREX brand pipe
- ☐ Bulletin PE-33 on heat exchangers
- ☐ Bulletin PE-30 on glass drainlines
- ☐ Bulletin PE-4 on new Y-valve

Name.....Title.....

Company.....

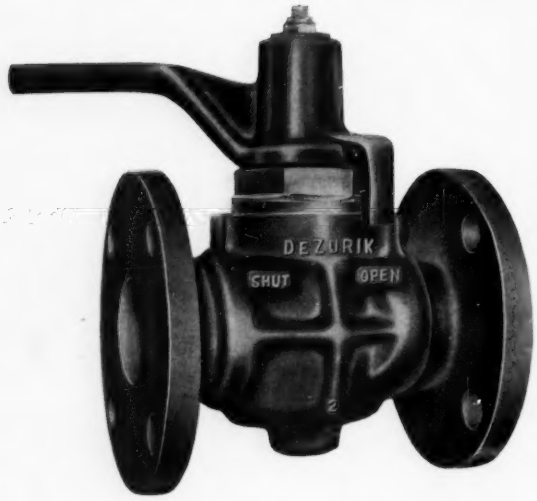
Address.....

City.....Zone.....State.....

DeZurik

PLASTIC-COATED

VALVES



DeZurik Eccentric Valves can now be furnished with plastic coatings. With plastic coatings, the corrosion resistance of a cast iron valve is greatly increased at only a slight increase in price.

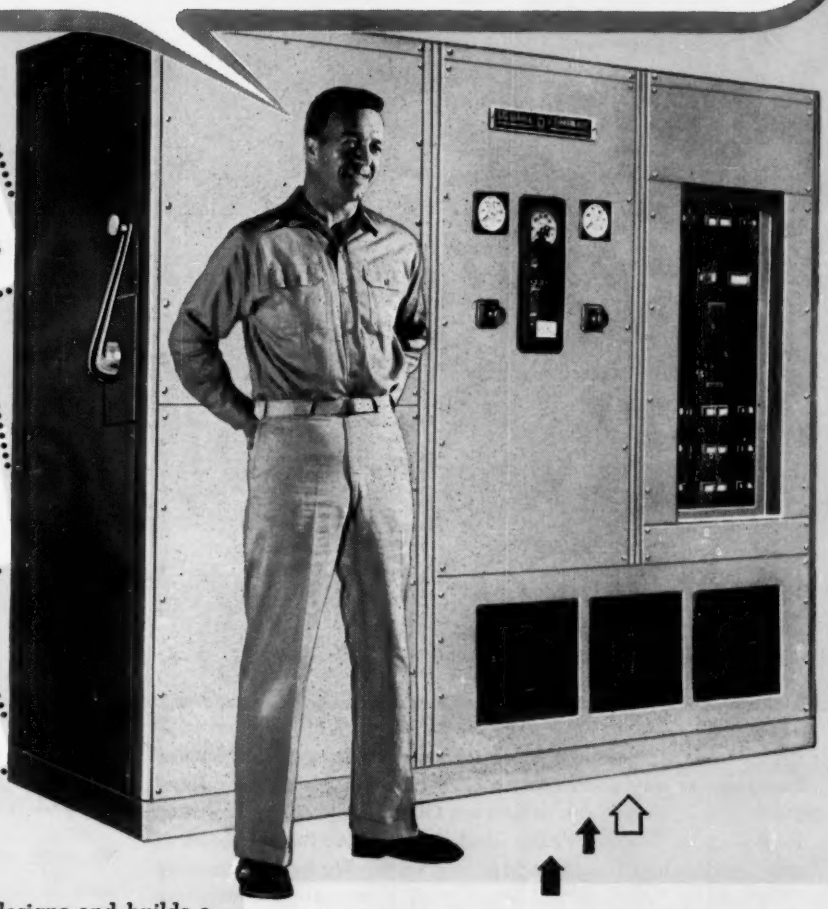
DeZurik Plastic-Coated Valves are the economical answer to valving alkalies, mild acids, sea water and other neutral salts. They are also particularly suitable for de-ionized and de-mineralized water where iron contamination is objectionable.

Coated or uncoated, DeZurik Eccentric Valves can provide the positive answer to your valving problems.

For more information,
contact the DeZurik representative in your area,
or write Dept. PC.

DeZURIK CORPORATION
SARTELL, MINNESOTA

Power-zOne UNIT SUBSTATIONS
HAVE EVERYTHING...INCLUDING COMPACTNESS!



Can be moved through normal commercial doorways

Save valuable space —can be placed against the wall

Capacities up to 300 KVA

• Square D designs and builds a complete line of substations for any application, indoor or outdoor—with dry or liquid-filled transformers—with large air-breakers or molded case breakers—with motor control units.

If you have any questions pertaining to substations, call in your Square D Field Engineer or write for literature describing space and cost saving with Square D's "*Power-zone*" design.

Address Square D Company, 6060 Rivard Street, Detroit 11, Michigan.

Power-zOne DESIGN PAYS OFF!

MINIMUM SIZE AND EASY HANDLING

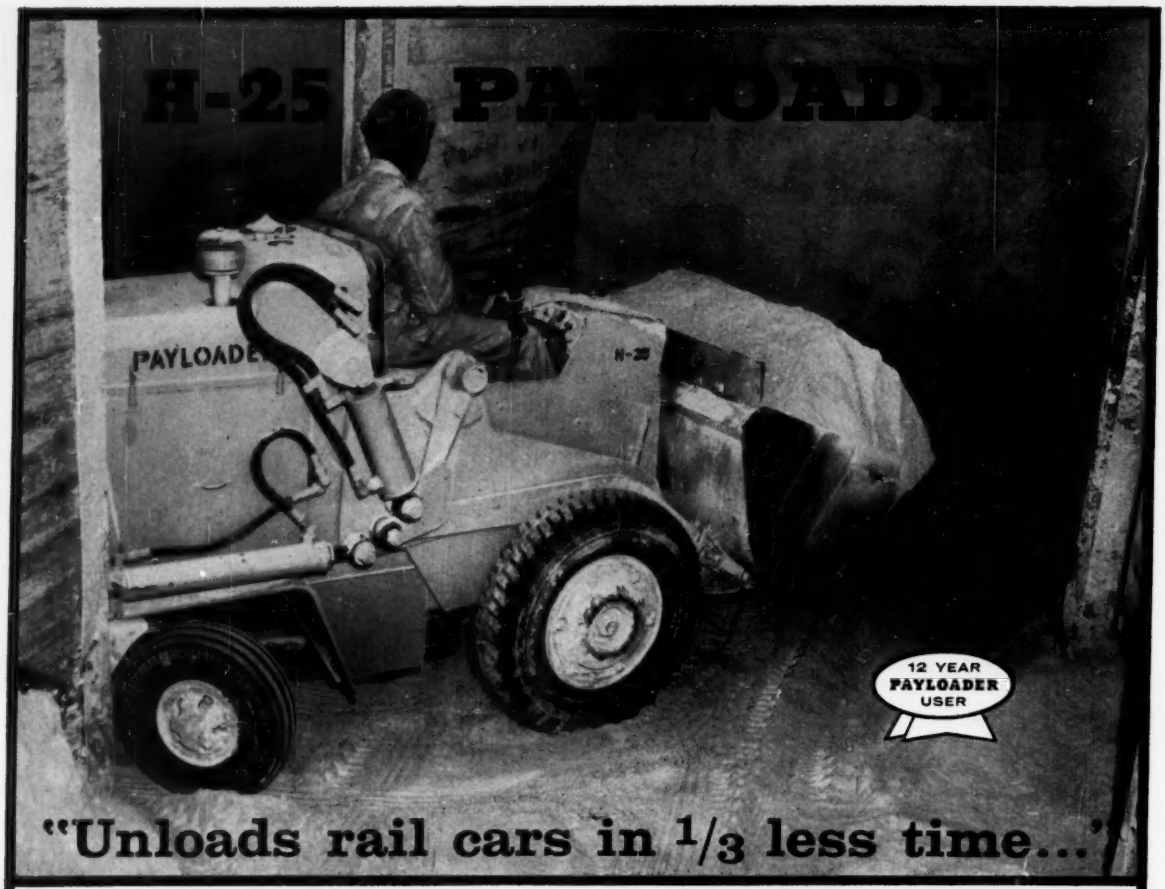
- Only 79½" high, 36" deep and 94" wide
- All components front-accessible

EQUIPPED TO BEST FIT YOUR APPLICATION

- **High Voltage** • Air interrupter switch or oil cutouts, fused or unfused
- **Transformer** • Dry type; quiet; up to 300 KVA and up to 5 KV primary; winding taps easily accessible through front grille
- **Low Voltage** • Molded case circuit breakers; QMB fusible switches and motor starters; metering equipment. Full 72" of panel space available for these devices

EC&M HEAVY INDUSTRY ELECTRICAL EQUIPMENT...NOW A PART OF THE SQUARE D LINE

SQUARE D COMPANY



"Unloads rail cars in 1/3 less time..."

" . . . It's fast and has adequate power to get full bucket loads under any conditions existing in our plant", continues D. W. Brant, Plant Supt. of Screven Oil Mill, Sylvania, Ga. "The H-25 is daily proving it's the ideal size machine for all phases of our fertilizer and limestone handling work. We have been using "PAYLOADER" units for 12 years with outstanding, continuous service and low repairs."

If you want top production from a six-foot-turning-radius machine, you should try a Model H-25. In carry capacity, in output, and in proven dependability it has no equal.

Other proven "PAYLOADER" models are also available, from 2,000 to 12,000 lbs. carry capacities, to meet your every material handling need. Your Hough Distributor is ready to serve you. See him today.

Maneuverability and Speed . . .

The H-25 with 2,500 lb. carry capacity, only 6 ft. turning radius and easy power steering, is the most concentrated package of tractor-shovel productivity ever designed. Power-shift transmission with two speeds forward *and* reverse, power-transfer "no-spin" differential, and 4,500 lbs. of bucket break-out force are other outstanding features that speed production and reduce operator effort.

THE FRANK G. HOUGH CO.
754 Sunnyside Ave., Libertyville, Ill.

☐ Send full facts about the H-25 PAYLOADER ☐ Other PAYLOADER Models

Name _____

Title _____

Company _____

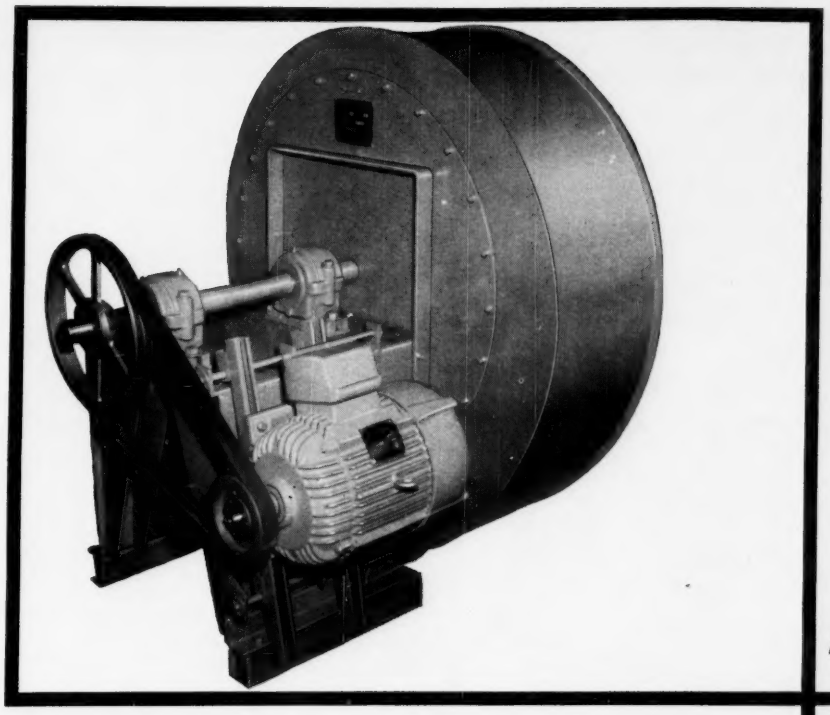
Street _____

City _____ State _____

6-A-1

HOUGH®

THE FRANK G. HOUGH CO.
LIBERTYVILLE, ILLINOIS
SUBSIDIARY — INTERNATIONAL HARVESTER COMPANY



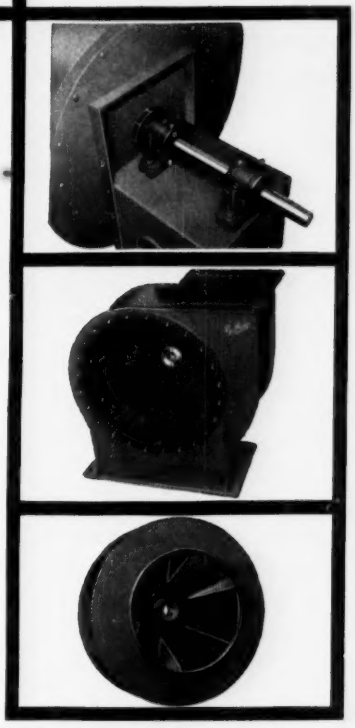
From Rugged Hot Gas Applications To Tough Materials Handling Jobs...

"BUFFALO" EXHAUSTERS CAN TAKE IT!

"Buffalo" Industrial Exhausters are ruggedly built, highly efficient heavy duty fans designed for a wide variety of applications. Husky steel plate housing is welded throughout. Adjustable to any discharge direction. Reversible for clockwise or counter-clockwise rotation. Available in numerous arrangements for many severe air and materials moving jobs. These include:

- **Moving Hot Gases** — 200° F. to 850° F. For this purpose units are equipped with heat slingers, high temperature ball bearings and/or separated steel bearing subbase.
- **Handling Corrosive Fumes.** Installations have proved that "Buffalo" Rubber-Lined Exhausters will outlast metal fans up to twelve to one. Rubber is vulcanized directly to all metal parts exposed to acid fumes.
- **Materials Moving.** Type "MW" material wheels are available for moving emery dust, saw dust, chips, long shavings and many other types of materials.

Investigate the advantages of "Buffalo" Industrial Exhausters for your severe air or materials moving jobs. Phone your "Buffalo" engineering representative, or write for Bulletin FI-110.



Upper: Heat Slinger for cooling shaft and bearings on a "Buffalo" Hot Gas Exhauster.

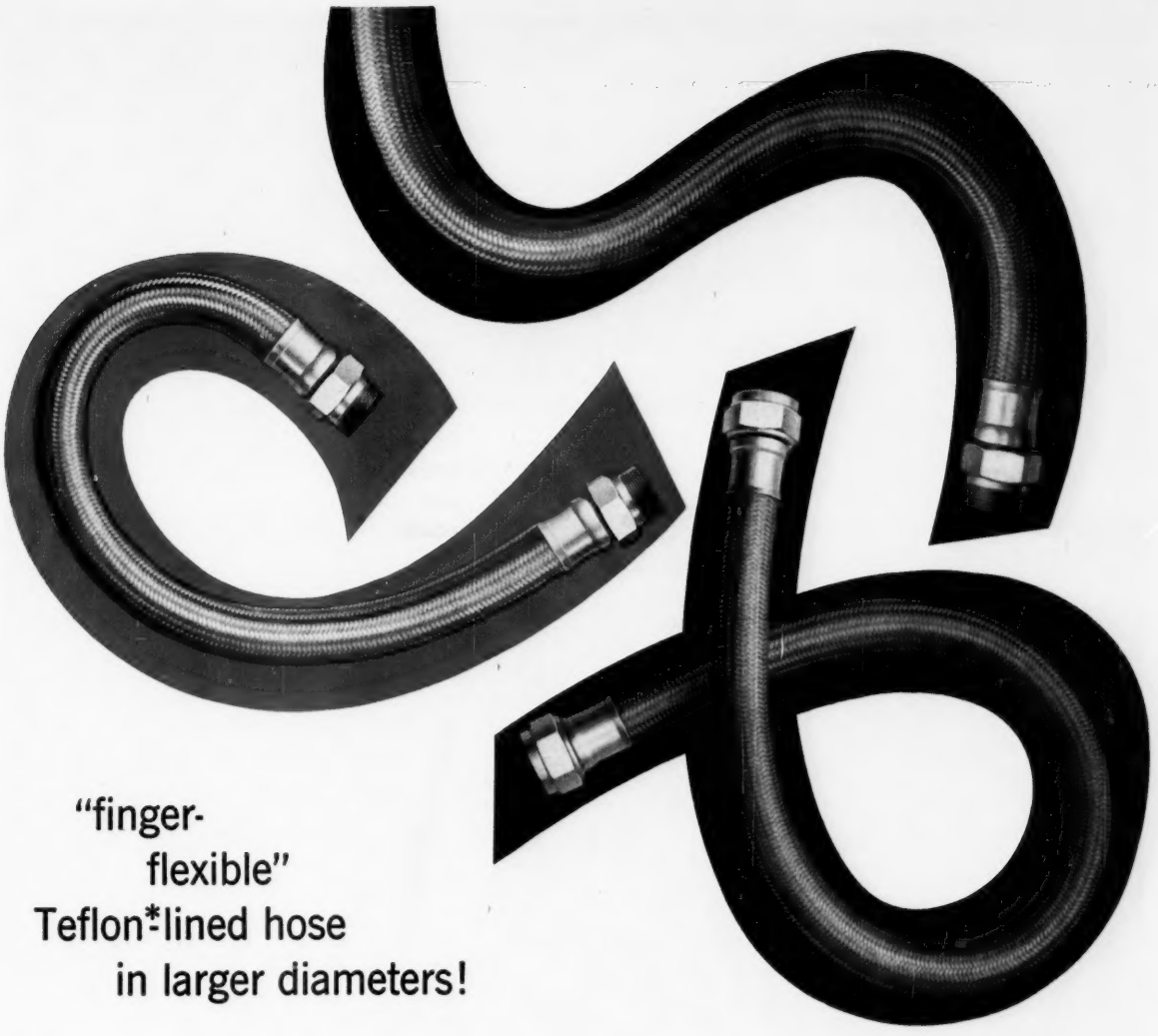
Center: "Buffalo" Rubber-Lined Exhauster for corrosive fume handling.

Lower: "Buffalo" Type "MW" Material Wheel.

BUFFALO FORGE COMPANY
Buffalo, N. Y.

Buffalo Pumps Division • Buffalo, N. Y.
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING EXHAUSTING — AIR CLEANING FORCED DRAFT — AIR TEMPERING COOLING HEATING — INDUCED DRAFT PRESSURE BLOWING



"finger-flexible" Teflon*-lined hose in larger diameters!

Only TITEFLEX has it! Its name: Springfield "400"**

For the first time you can buy Teflon hose that *really* flexes, even in *large* diameters. TITEFLEX makes it with an exclusive process, and its minimum bend radius is only 3½ times the hose diameter!

CHECK THESE WANTED FEATURES:

- Often, a shorter Springfield "400" assembly can replace extruded hose at a saving in money.
- Available in lengths to 25 feet (soon to 50!) and diameters of ¾", 1", 1¼", 1½", 2"—and soon—3" and 4".
- Teflon is tough, friction free, lightweight, inert, corrosion and temperature resistant, with extra long fatigue life.
- Reinforced with TITEFLEX "zero motion" braiding.
- Assembly terminations: Elbow fittings of any configuration to your order. JIC Swivel Nuts and Male Pipe Threads, AN Swivel Nuts, MS 20756 Flanges. All guaranteed failure-proof to burst pressure of hose.

Already, Springfield "400" is in use for transferring acids, alcohols, methanol and most corrosive fluids . . . for live steam lines . . . for extremely high and low temperature systems. Our data sheets contain answers to your needs. Get a copy from your TITEFLEX distributor or write direct to us. Stocks available at authorized distributors in your area.

*Teflon is a duPont trademark **T.M. of Titeflex, Inc., Pat. Pending

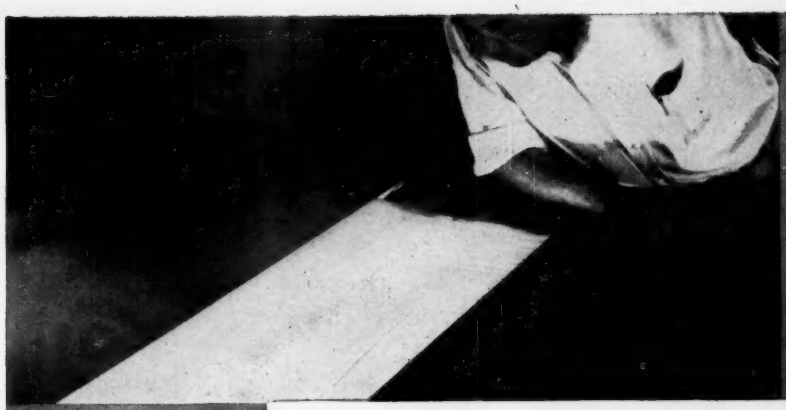
SPRINGFIELD "400" DIMENSIONS AND PERFORMANCE

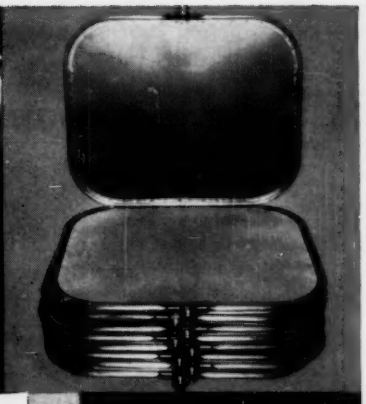
(Hose assemblies rated for performance at operating pressures shown—through temperature range of −65° to 400° F.)

Nom. Size	"B" Inside Dia.	"A" Outside Dia.	Approx. Weight Lbs/Ft	Min. Bend Radius	PRESSURE, P.S.I. Min. Burst.	Max. Test	Max. Working
¾"	.784	1.067	.34	2½"	2,000	1,000	500
1"	.992	1.262	.40	3½"	2,000	1,000	500
1¼"	1.290	1.555	.50	4"	1,400	700	350
1½"	1.522	1.790	.60	5"	1,000	500	250
2"	1.987	2.315	.94	6¾"	1,000	500	250

titeflex

titeflex inc. springfield mass. PACIFIC DIVISION • SANTA MONICA • CALIFORNIA





Who makes and meets your Wire Cloth Specs?

CAMBRIDGE does . . .

To assure you of wire cloth fabrications that give long and satisfactory performance, we have experienced engineers who can draw up prints for your approval if necessary, and trained production men who can quickly and accurately fabricate parts to your most rigid specifications.

To fill your most diversified bulk wire cloth needs, we have thousands of items in stock—in all meshes, wire sizes, metals or alloys—ready for prompt delivery.

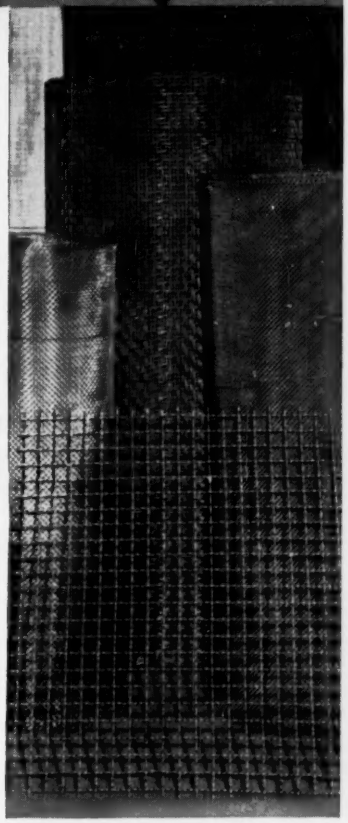
Modern machinery, careful workmanship and constant inspection assure you of exact mesh count and mesh size. And, our field engineers follow up your order to see that our product is giving the best possible service.

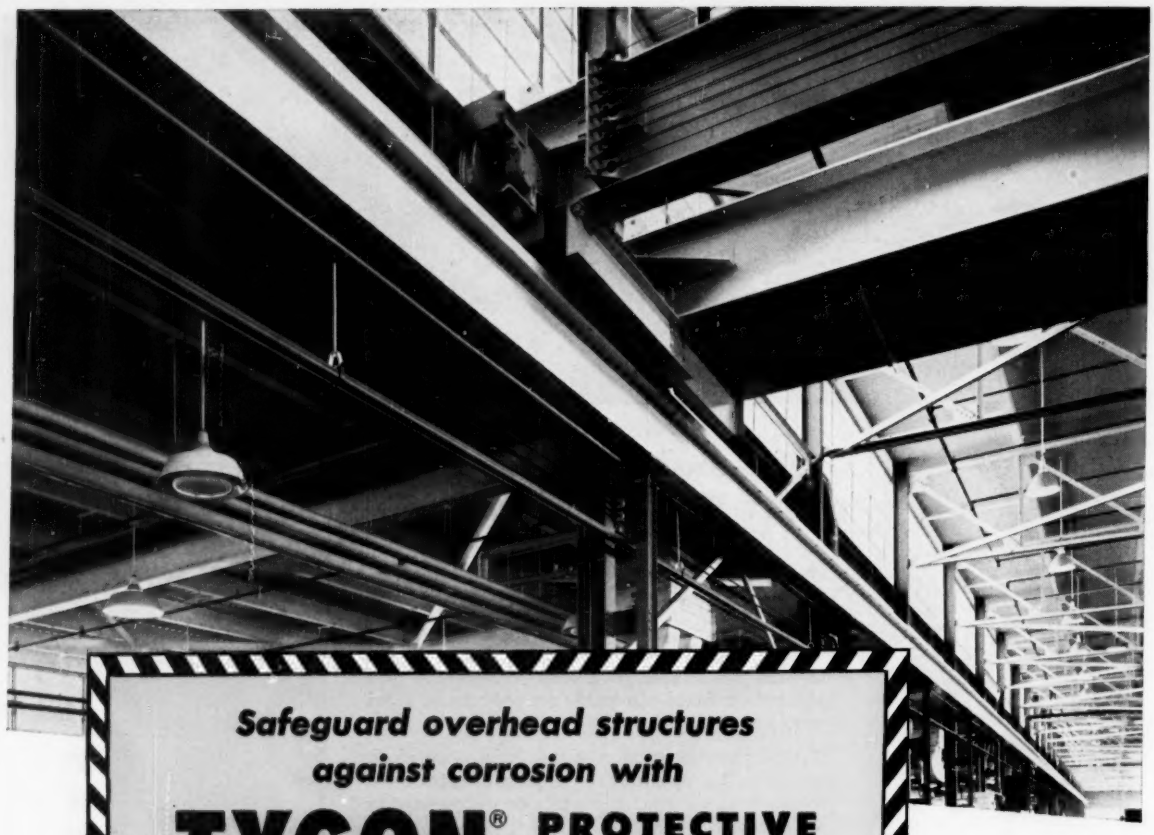
We make wire cloth from any metal or alloy—including titanium—in nine basic weaves—from finest to coarsest mesh. Call your Cambridge Field Engineer for information. He's listed in the yellow pages under "Wire Cloth". Or, write for FREE 94-PAGE CATALOG.

The Cambridge Wire Cloth Co.

Department G • Cambridge 61, Md.

Manufacturers of Wire Cloth, Metal-Mesh Conveyor Belts, Wire Cloth Fabrications





Safeguard overhead structures against corrosion with

TYGON® PROTECTIVE COATINGS

Have you checked your ceilings recently?

It pays to keep a sharp eye on the overhead structures in your plant, for corrosive fumes and gases can readily damage poorly protected walls, fixtures, ceilings, and other structural members. Unless detected in time, and corrective action taken promptly, such damage can be severe and costly.

So it's wise to make periodic inspections of those higher areas. And if you find "trouble spots" where present coatings are not giving adequate protection, Tygon Paint, with its exceptionally broad range of corrosion-resistant properties, is usually the recommended answer.

We don't claim that Tygon provides "universal" corrosion protection. Engineers know there is no "all-purpose" coating. But just about everywhere that protective coatings must withstand the effects of corrosive fumes and chemicals, specialized Tygon Coatings are meeting the challenge — providing longer service at lower long-term cost.

Send for this Tygon Data Book today. It contains complete application details plus helpful information on performance of Tygon Paint over a wide range of corrosives.

OUR 100th YEAR

PLASTICS AND SYNTHETICS DIVISION

U. S. STONEWARE

AKRON 9, OHIO

444-F

DEVELOPMENTS...

JUNE 1, 1959

Chementator

C. H. CHILTON

Esso's all-butyl tire is now commercial. Esso put new tire on sale last month in its 18-state marketing area, plugging shorter stopping distances as big selling point.

SO_2 in flue gas reduces hexavalent Cr to trivalent in plating wastes at General Motors' Elyria, Ohio, plant. Scrubbing step precedes alkaline precipitation.

Fansteel is getting set to pilot a new improvement in Ta-Cb production "which goes considerably beyond" its recent developments in Ta-Cb separation. Company is mum on further details.

Brown & Root is building first Giammarco-Petrocoke plant in U. S. for Trans-Western Pipe Line Co. at Fort Stockton, Tex. Due on stream this autumn, plant will remove H_2S and CO_2 from 180 MM cu. ft./day of natural gas.

New hope for chlorine from HCl

Economical electrolytic regeneration of chlorine from byproduct HCl is the prospect promised by the well-known Italian engineering firm, De Nora, and Monsanto Chemical, De Nora's U. S. agent. Monsanto has a pilot unit in successful operation at Anniston, Ala.

Monsanto's F. M. Berkey presented an optimistic picture of this development at the Electrochemical Society's meeting in Philadelphia last month. Estimated investment for a plant to recover 20 tons/day of chlorine is $400,000, or only $20,000 per daily ton. Power consumption is 1,750 kwh./ton. Based on electricity at 1¢/kwh. and 10% depreciation, estimated recovery cost is $36/ton.

The De Nora electrolysis unit is a filter-press-type assembly of individual cells. Single cell voltage is 2.3. Proposed commercial unit would consist of 40 cells (Monsanto's unit has 35) with an over-all voltage drop of 92 v. when passing 1,500 amp. to make 3,900 lb./day of chlorine.

Electrolyte is a solids-free HCl solution which enters at 33% concentration and exits at 18%. Gaseous HCl feed is absorbed in depleted electrolyte to bring it up to strength.

Recovery of chlorine from HCl has challenged chemical engineers for many years. Previous attempts by U. S. producers—either by electrolysis or by chemical oxidation—have met with technical or economic failure.

Ethylene yields acetaldehyde directly

A new way to make acetaldehyde—by direct oxidation of ethylene—has aroused interest among chemical engineers on both sides of the Atlantic.

Responsible for this development is Consortium fuer Elektrochemische Industrie GmbH., Munich, Germany. The new process—already tested through pilot-plant stage—differs from conventional ethylene-based acetaldehyde processes in that the latter involve production of ethanol as an intermediate.

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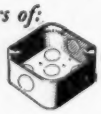
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Consortium uses a palladium dichloride catalyst. Process begins in a tower, where a rising ethylene-containing gas stream reacts with a descending 0.1*M* aqueous solution of $PdCl_2$ as follows:

$$C_2H_4 + PdCl_2 + H_2O \rightarrow CH_3CHO + Pd + 2HCl$$

Yield is over 90%. Liquid from the tower, containing the reaction products, goes to a still which strips off crude acetaldehyde. Spent catalyst is then regenerated by air oxidation in another tower, where this over-all reaction occurs:

$$Pd + 2HCl + \tfrac{1}{2}O_2 \rightarrow PdCl_2 + H_2O$$

This reaction itself is slow. But it can be speeded up by the presence of cupric (or ferric) chloride. The $CuCl_2$ actually serves as oxidizing agent for the Pd, forming CuCl, which in turn is easily reoxidized to $CuCl_2$ by air.

Chief advantages of the Consortium process, it is claimed, are low investment and ability to use cheap raw materials. Consortium believes the same technology might be applied economically to make acetone from propylene and methyl ethyl ketone from normal butylene.

Though Consortium—a 100% subsidiary of Wacker-Chemie—has not announced licensing plans, *CE* has learned that several companies already are definitely interested in the process. Hoechst-Uhde International GmbH., New York, will probably be licensing agent in U. S. and Canada.

Water softening yields process lime

While gold from sea water still challenges the imagination, extraction of lime from fresh water is a commercial reality.

Buckeye Cellulose Corp.'s wood pulp mill at Foley, Fla., now gets most of its requirements of lime—amounting to 50 tons/day—from a new fully integrated water-softening and lime-recovery system. These facilities were installed as part of a just-completed $20-million expansion project which added 100,000 tons/yr. to Buckeye's dissolving pulp and paper pulp capacity.

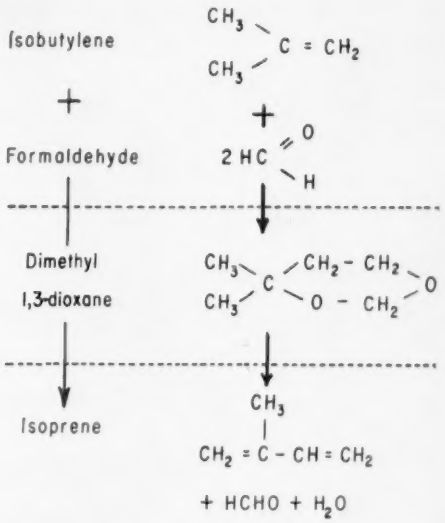
Utilization of recovered lime will save the company up to $5,000/mo. Added advantage is elimination of lime sludge disposal problems, including maintenance of several acres of lagoon area and periodic removal of dried sludge from lagoons.

Water used at Foley—40 million gal./day from deep wells—has a hardness rating of over 200 ppm. The plant's cold-lime softeners reduce this to 80 ppm., pulling out about 100 tons/day of $CaCO_3$ sludge. Chief impurities in the sludge are Mg and Fe.

In order to be able to use this lime in the causticizing circuit, Mg compounds must be removed to prevent their buildup beyond a tolerable level.

This was a major deterrent until Buckeye engineers found that carbonation of the 10%-solids sludge, followed by centrifugal classification and dewatering, would effectively purge the impurities from the lime. Roughly four fifths of the lime is recovered as 60%-solids cake suitable for feed to the calciner.

Make isoprene from isobutylene

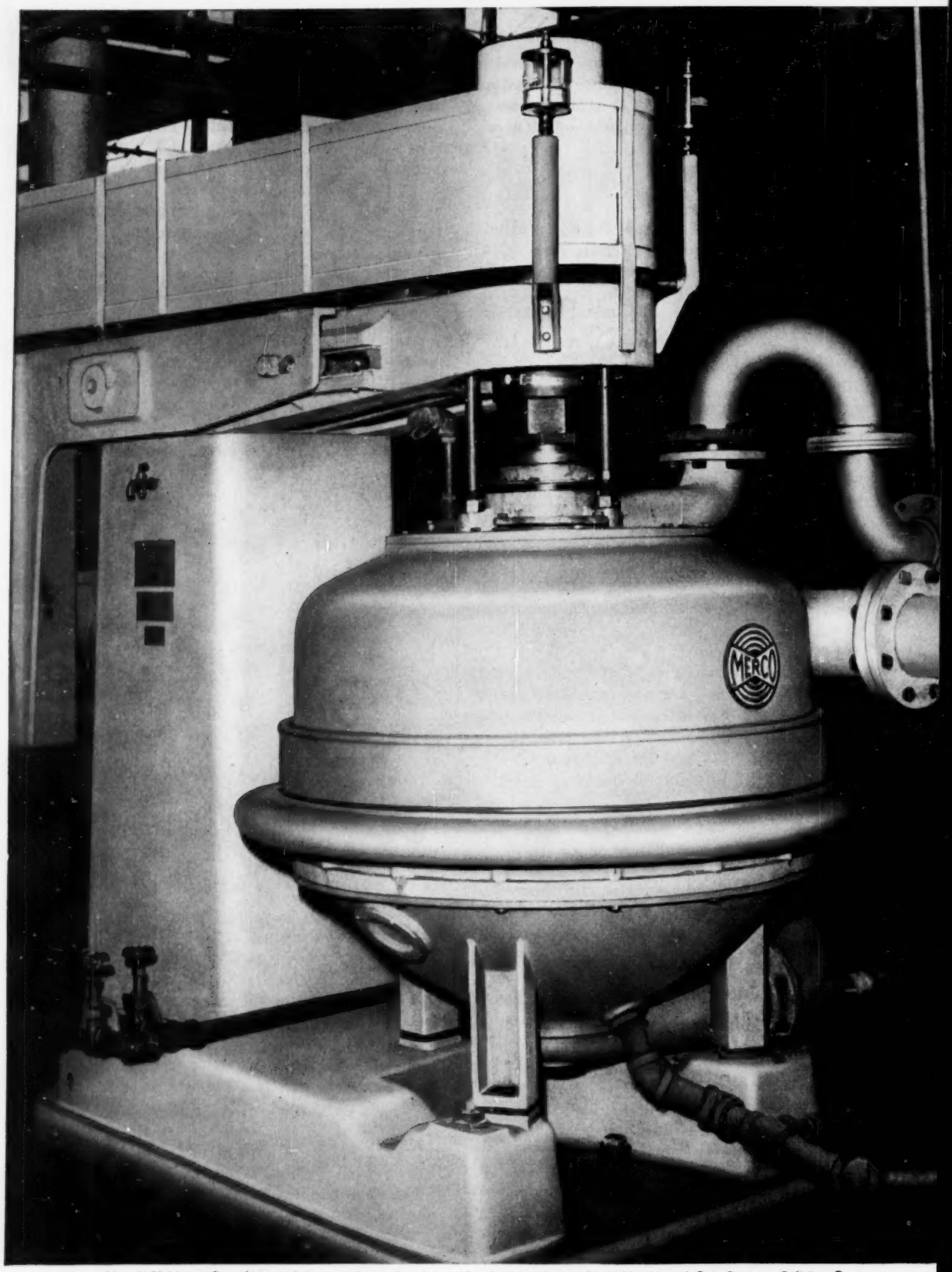


Oil, chemical and rubber industry representatives at the World Petroleum Congress in New York this week will be eagerly seeking details on the isoprene process outlined above.

In the spotlight will be spokesmen for Institut Francais du Petrole who are presenting a formal paper to the congress on their fledgling process. The Frenchmen will draw on IFP's experience with a 1,600-ton/yr. pilot plant.

Process is of special interest because it starts with readily available, low-cost materials. You can use a C_4 refinery cut containing as little as 10% isobutylene. And where

(Continued on page 38)



New H-30 Merco Centrifuge with increased speed and capacity, in operation at Argo, Ill. plant of Corn Products Refining Co.

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increased capacity in NEW MERCO CENTRIFUGE for nozzle bowl applications

Rotor speeds up to 3300 rpm and capacities up to 600 gpm are now possible with the new, improved H-30 Merco Centrifuge. At the same time, power requirements per gallon of feed have been substantially reduced.

In the first two installations, this new unit produced comparable removals at nearly double the capacity of previous models . . . and showed *no increases* in total power consumption.

This new operating efficiency is a result of improvements in rotor design, which provides greater disc area. Feed passages have been enlarged to accommodate increased flow.

The new Merco H-30 Centrifuge is particularly useful for clarification and thickening of slurries which contain fine solids (0.5 micron) over a wide range of feed solids concentrations (.02% and up). It is now available with a 30″ stainless steel rotor and bronze or stainless steel housing. In addition to its new large capacity and higher speeds, it contains these standard Merco benefits:

- The unique return flow principle that permits concentrating, washing, clarifying, classifying and recovery of soluble values at pressures up to 150 psi.
- No nozzle clogging or solids build-up in the unit.
- Overhead drive eliminates need for submerged bearing.
- Hydraulic hoist is built in to simplify inspection and maintenance.

If yours is a process that needs a large capacity centrifuge, there is a place for the Merco H-30 in your plant. For further information, write to Dorr-Oliver Incorporated, Stamford, Connecticut.

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supply of formaldehyde might be a problem, IFP recommends that you start with methanol and integrate production of formaldehyde (via methanol oxidation) into the isoprene plant.

Here's what you need to make 1 lb. of isoprene, according to IFP figures: 0.66 lb. methanol; 0.99 lb. isobutylene; 21.7 lb. 300-psi. steam; 96 gal. cooling water; 0.18 kwh. electricity; 0.26 lb. fuel oil. You also get a bonus of 0.225 lb. of byproducts, such as C_4 and C_5 alcohols and diols. Estimated investment for a 40,000-metric-ton/yr. plant in the U. S. is $10 million.

Low-cost isoprene is the key to economical production of cis-1,4-polyisoprene, a polymer with many of natural rubber's desirable properties. Shell Chemical's recent unexpected introduction of competitively priced polyisoprene (*Chementator*, Apr. 6, p. 67) must be based on a significant breakthrough in isoprene technology, say industry observers.

With the IFP process now available for licensing, you can look for further activity in this exciting field.

Water-based acrylics move outdoors

A movement quietly germinating for several seasons past has blossomed overnight.

A strong representation of the nation's major paint manufacturers—Du Pont, Sherwin-Williams, National Gypsum and Glidden—are starting broad marketing and advertising of water-based acrylic paints for exterior use. These companies are in or near full commercial production of competitively priced paints in a wide range of colors.

While polyvinyl acetate paints publicly came out of doors several years ago, their use has been pretty much limited to masonry. The new acrylics are the first water-based paints to claim effectiveness over wood too. Their broad aim is to function as general-purpose exterior coatings, a position still held by traditional oil-based paints. And an impressive stronghold it is, with $250 million/yr. sales.

In addition to the familar ease-of-application advantage of water-based paints, the newly unveiled acrylics claim such performance advantages as: Can be applied in the rain; dry to the touch in 20-30 min.; unmatched resistance to fading, yellowing, cracking, blistering and peeling; 50% longer life than premium oil-based finishes.

To be safe, paint manufacturers today are recommending careful surface preparation with an oil-based primer, particularly over bare wood. However, they hope that before long these oil-based primers can be replaced by a water-based variety or eliminated altogether.

Some suppliers of the film-forming acrylic resins (Dow for one) are very optimistic. Dow, a new entry in the acrylics field with its Latex 2647, has been working with Glidden to develop its new formulations. Among other resin suppliers are Rohm & Haas (Rhoplex AC-33), Monsanto (Lytron 680) and Borden (Polyco 2719 and 2755).

Chemicals sweeten diesel bus fumes

An odor-masking chemical is now being added to diesel fuel used by city buses in Cleveland in an effort to make exhaust fumes less objectionable. This experiment is being conducted in cooperation with Standard Oil (Ohio) and General Motors.

Tests began late in April on 190 buses operating out of a West Side garage. Residents of this area had complained strongly about exhaust fumes.

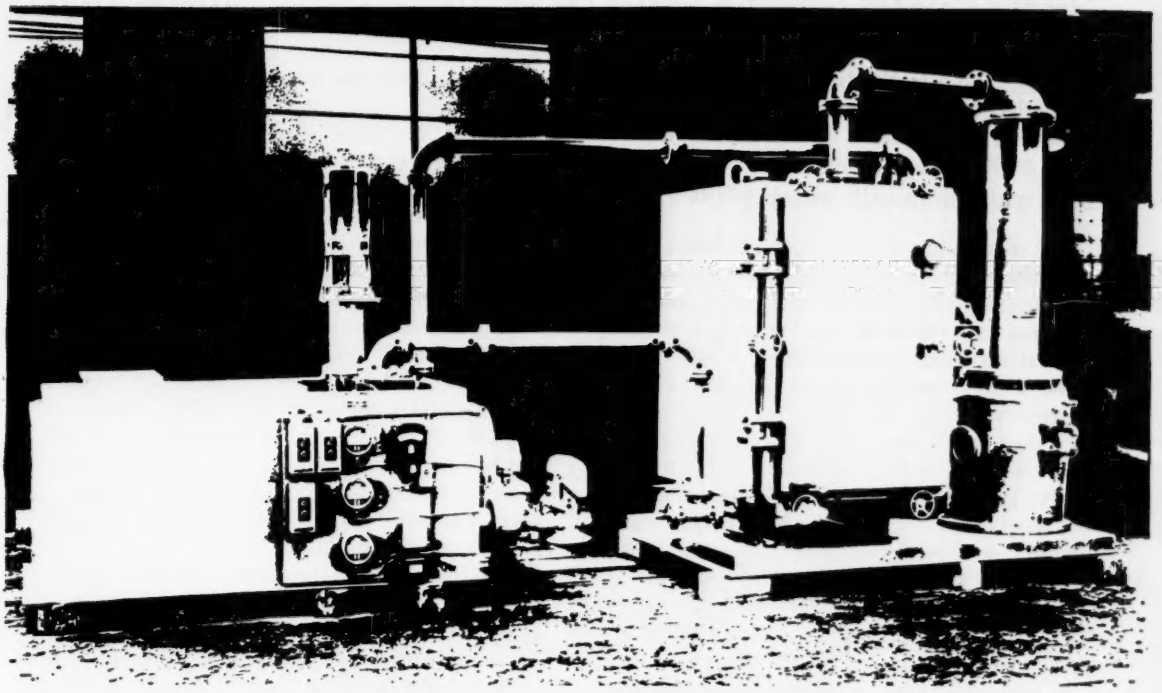
Although this idea has been used for more than a year by diesel buses in Edmonton, Alta., Cleveland is the first U. S. city to try it. Another Midwest city (as yet unidentified) will soon take a crack at it; this will also be a joint study with GMC and a major oil company.

Competing for this potential market are Rhodia, Inc., and Sindar Corp., makers of odor-masking chemicals. Cleveland is using Sindar's Deodall No. 1. Rhodia furnishes Alamask DI-2K to Edmonton and will provide this material to the second U. S. city.

Cost of treatment is roughly the same for the two chemicals—about ¼¢/gal. of fuel. Sindar's product sells for 35¢/lb. and is used at a concentration of 0.1% by weight. Rhodia's product sells for $1.35 but is effective at only 0.02%. Neither company will identify its product chemically aside from Sindar's general categorization of Deodall as a mixture of terpene chemicals.

Just how these chemicals can pass through a diesel engine and retain any of their original odor-masking properties is an unexplained mystery. Proof of the pudding seems to lie in the smelling. The companies also claim less eye irritation from exhaust.

It would make more sense to aspirate a perfume into the exhaust itself rather than



J. P. DEVINE Engineering solves another Chemical Processing Problem

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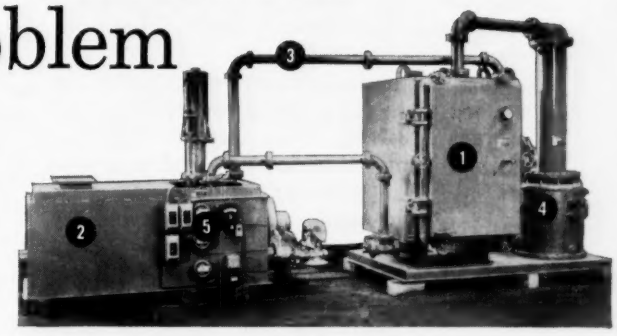

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Vacuum pump (behind condenser)

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Other Devine products for the Chemical Processing Industry: Vacuum Dryers, Blenders and Mixers, Ball Mills, Flakers, Autoclaves, Agitators, Code Design and Fabrication

add something to the fuel. This is being done in Philadelphia. But cost of this technique, according to Sindar, is 10-20 times more.

New aluminum cells reach giant size

Trend to bigger and more efficient electrochemical cells continues as Pechiney, French aluminum giant, reports successful operation of three experimental 150,000-amp. aluminum cells at its Auzat plant in the Pyrenees. Cells have undergone three years of trial and adjustment.

Pechiney's new plant near the Lacq natural gas field—which will be served with gas-derived power—is being equipped with 100,000-amp. cells because the 150,000-amp. ones weren't completely satisfactory when design of the new plant had to be frozen.

However, the company predicts that the cells in this new plant will hit a new low in power consumption—6.5 kwh./lb. Up to now, 7.5 kwh./lb. was considered good performance, even though theoretical energy needed is only 3.5 kwh./lb. of aluminum.

Biggest known cells in commercial operation are used by Reynolds at two plants in this country (*Chem. Eng.*, May 1955, pp. 117-120). These are believed to operate at 125,000-135,000 amp. Other U. S. producers use 100,000-amp. cells, some of them of Pechiney design, in their newest plants.

Big cells mean less investment and lower operating costs per pound of production. But there are offsetting disadvantages. Pechiney engineers admit that intensity of magnetic fields is a real problem with big cells, that cells must be carefully designed to avoid unfavorable effects on the metal within.

Unless still larger cells can show lower power consumption—and 6.5 kwh./lb. is going to be hard to beat—Pechiney engineers think that 150,000 amp. is about the top limit.

Urethane rubber gets solid footing

Switch from batch to continuous production of cast urethane elastomers—a trend now getting under way—will count heavily in bringing output from less than 1 million lb. this year towards an estimated potential market of 50-60 million lb./yr.

Such are the expectations of Mobay Chemical Co., which has just publicly announced development of the first continuous casting equipment. This equipment, available to Mobay licensees, has already been installed by two solid urethane producers.

Cast urethane elastomer has up to 30 times the wear resistance of natural rubber. Markets are in heavy-duty truck parts, construction and mining equipment, gears and shock mounts.

However, production has been limited because small batches of chemicals had to be carefully hand-mixed just prior to casting. With the batch process, one man could produce 30 lb./hr. at best. In the continuous method, one man can turn out 180 lb./hr. now, and output of 600 lb./hr. is foreseen. The new equipment accommodates castings up to 96 lb. Batch process, to produce castings that size, would require readying ten batches at once.

Casting equipment includes two reservoirs, for chain extender and prepolymer. Through steam-jacketed copper pipes, ingredients are fed at 110 C. in proper proportions into a mixing head. Head is kept completely full to prevent formation of air bubbles. Air-free mix flows directly into the mold.

A stable prepolymer is, Mobay states, essential to continuous casting. Mobay favors diphenyl methane diisocyanate over the more conventional 1,5-naphthalene diisocyanate.

Ti, Si organics work well together

Recent developments in two unrelated fields show a parallel which we think is significant. They involve the use of titanium esters to enhance silicone coatings.

Southern Research Institute, Birmingham, Ala., found that silicone coatings could be deposited on extracted bovine teeth if the teeth were first treated with a suitable primer, such as tetrabutyl orthotitanate. SRI has been studying the suitability of various coatings, such as silicones, for protecting dental enamel from development of caries.

And *Textile World* recently reported that British textile researchers obtained greatly improved water repellencies with silicones by adding a suitable proportion of triethanolamine emulsion of titanic acid to the silicone treating bath. Comparative tests used a 2% silicone emulsion vs. a mix of 1.875% silicone and 0.125% TEA titanate. Actual penetration of water into the fiber was 33 times less for the silicone-Ti mix. Fomulation works well on acetate, wool, Dacron, nylon or cotton.

For more on DEVELOPMENTS.....42

NOW! General Chemical offers 2 New Brochures on SULFAN® stabilized sulfuric anhydride

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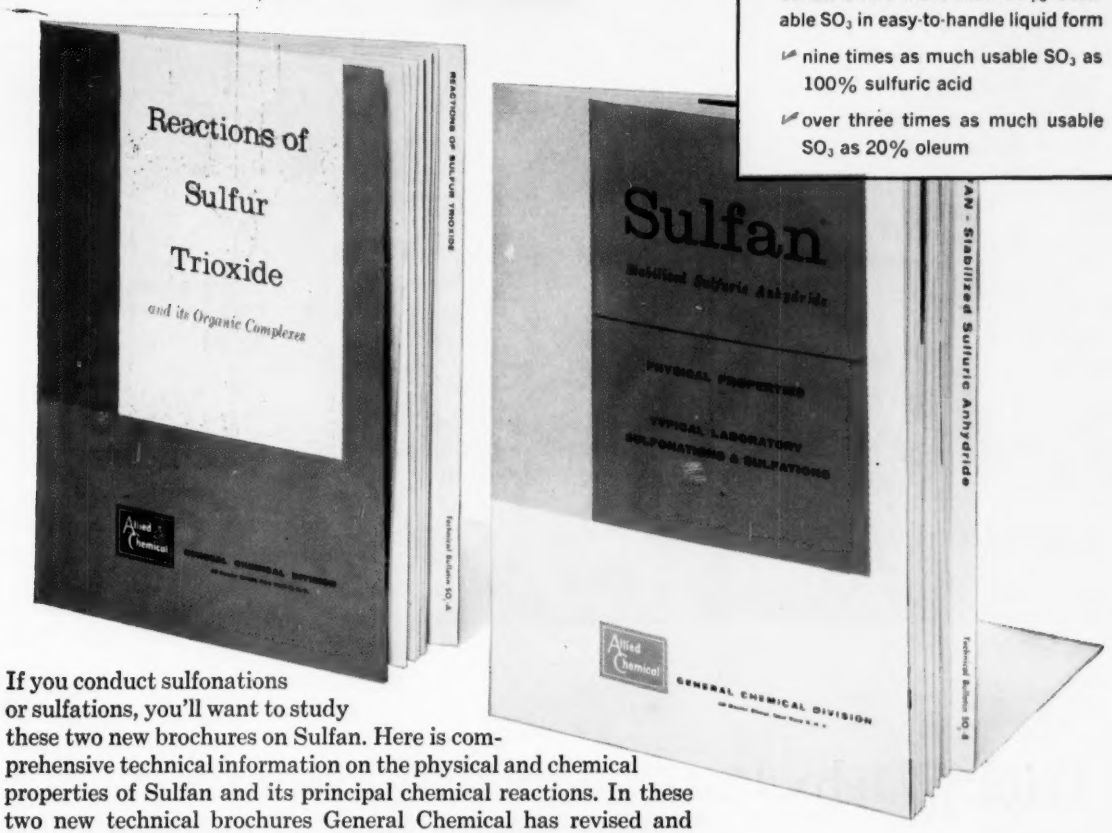

If you conduct sulfonations or sulfations, you'll want to study these two new brochures on Sulfan. Here is comprehensive technical information on the physical and chemical properties of Sulfan and its principal chemical reactions. In these two new technical brochures General Chemical has revised and brought up to date the literature previously available on Sulfan. New information has been incorporated. Be sure to send for your copy of:

"Reactions of Sulfur Trioxide" (20 pages)

Covers reactions of SO_3 and its organic complexes (such as pyridine, dioxane, trimethylamine) with organic compounds to form sulfonates or sulfates. Although we have not attempted to give complete coverage of any particular reaction, you may be able to draw analogies respecting reaction rates, temperatures, solvents and other conditions which can lead to successful and economical methods of employing Sulfan in new applications.

"Sulfan" (28 pages)

Compiled for those interested in sulfuric anhydride for fundamental research, product development or industrial production. Includes a description of the physical and chemical properties of Sulfan, correct procedures on handling and disposal, safety precautions, typical laboratory sulfonations, production of anhydrous HCl, fortification of spent acid with Sulfan and other helpful technical information.

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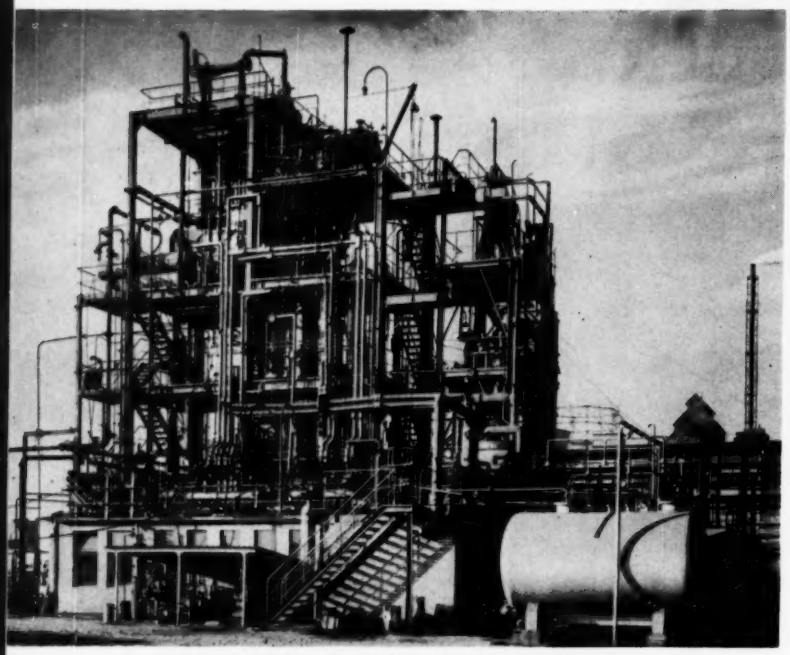
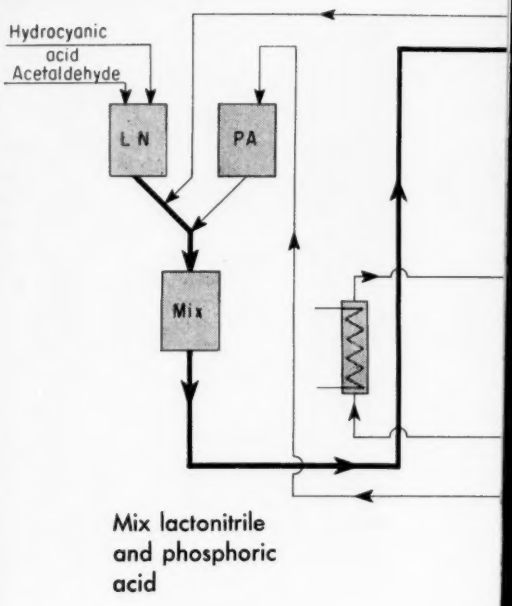




Tricky Dehydration Opens Monomer Route

New technique dehydrates unstable lactonitrile to acrylonitrile, opens way to new monomer synthesis that offers low cost, high yield and purity.

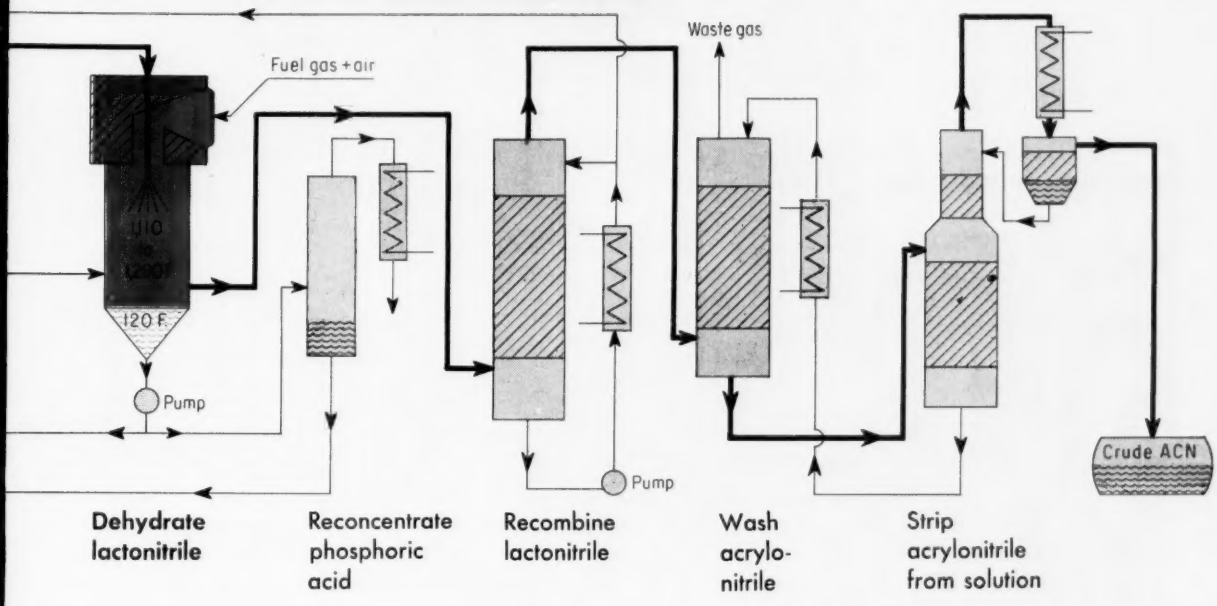
With one vital discovery, Germany's Knapsack Griesheim A. G. has solved a riddle that opens a lower-cost route to acrylonitrile monomer.

Starting with inexpensive acetaldehyde, Knapsack Griesheim has found a way to go through the previously unstable intermediate, lactonitrile, to acrylonitrile. And in so doing, KG's process outshines cost and performance of syntheses via acetylene and ethylene oxide.

▶**Tricky Dehydration** — Previous attempts to produce acrylonitrile from acetaldehyde failed because dehydration of lactonitrile to acrylonitrile at high temperature also decomposed the lactonitrile and ruined the yield. Knapsack prevents this decomposition by dehydrating the lactonitrile instantaneously in the presence of concentrated phosphoric acid (see flowsheet above).

Proved out with extensive runs in a 30-tons/mo. plant, KG's process is better defined than Sohio's new propylene-ammonia process, due to be operating full scale early in 1960.

About all Sohio will say is that its process is a highly selective, catalytic, vapor-phase synthesis. So it's pretty hard at this point to establish meaningful comparisons between KG and Sohio processes. But, we can draw clearer comparisons between the KG process and those based on ethylene oxide or acetylene.



► **Beats Ethylene Oxide** — KG's acetaldehyde process has the same number of steps as the ethylene oxide plus hydrogen cyanide process used by Union Carbide, only U. S. producer to deviate from acetylene.

Both KG and Carbide work from derivatives of ethylene, dispensing with need for more-expensive acetylene. But were it not for Carbide's large-scale captive production of ethylene oxide, this saving would be cancelled out by the relatively high cost of making ethylene oxide.

By comparison, acetaldehyde can be produced at 50-60% of the prime cost of ethylene oxide; process yields average 90% vs. 85% yield from ethylene oxide.

► **Outshines Acetylene** — This same type of advantage also stands out for KG's acetaldehyde process compared with the acetylene process, source of 70% of U. S. acrylonitrile.

Yield of acrylonitrile from acetaldehyde and hydrogen cyanide is 10% higher than from acetylene and hydrogen cyanide, on an equivalent basis of two hydrogen and two carbon atoms.

This higher yield and acetaldehyde's lower cost drop over-all cost of KG's starting materials 20% below the starting-material cost for acetylene-hydrogen cyanide route.

Since cost of materials represents about two-thirds of final acrylonitrile cost, such saving is noteworthy. And Knapsack conservatively estimates further savings of 10% on plant investment.

► **Other Gains, Too** — When Knapsack Griesheim compares its acetaldehyde process with the acetylene process, it adds other advantages to those of yield and cost.

Crude acrylonitrile from KG's process contains only small amounts of propionitrile and lactonitrile impurities. There are no close-boiling, unsaturated compounds such as plague acetylene-derived acrylonitrile.

Both propionitrile and lactonitrile have boiling points well separated from each other and from acrylonitrile. So, distillation produces an unusually pure acrylonitrile.

Inherently, KG's process is safer than acetylene process because the compounds react in a gas stream composed mainly of nitrogen. By eliminating acetylene and its copper catalyst, KG also has done away with possible formation of explosive cupric acetylides. Furthermore, there is no free hydrogen cyanide in the process.

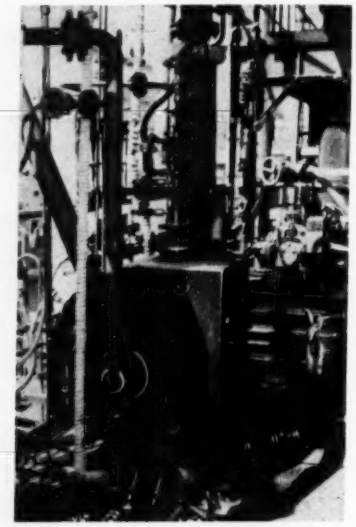
► **Only Two Steps** — The two main steps in the acetaldehyde process are: production and stabilization of the intermediate, lactonitrile; dehydration of lactonitrile to acrylonitrile.

In Knapsack's 30-ton/mo. plant, hydrogen cyanide is neu-

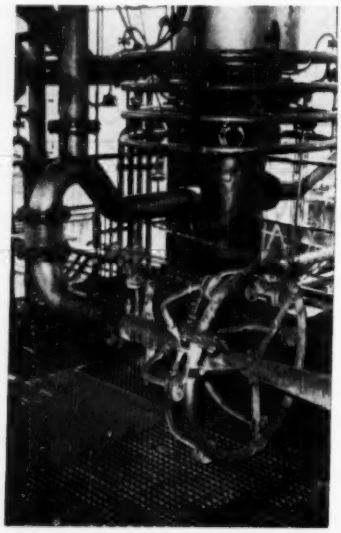
tralized to a pH between 6 and 8 with 20% caustic soda. A stoichiometric amount of acetaldehyde added with agitation produces lactonitrile which is then stabilized with 0.2-0.5% phosphoric acid.

Maintaining reaction temperature between 50 and 70 F., Knapsack produces 97-98% lactonitrile, pure enough for making acrylonitrile. A commercial plant could simplify lactonitrile production by going continuous, using impure hydrogen cyanide gas.

Vertical Dehydration Unit



TOP: **Combustion chamber feeds gases to heat H_3PO_4-nitrile mix.**



BOTTOM: **Effluent is quenched, then scrubbed in venturi tube.**

► **The Key Step** — Lactonitrile dehydration takes place in an atmospheric-pressure vertical tube.

To the stabilized lactonitrile, KG adds 80-85% phosphoric acid until the nitrile-acid ratio is about 2 to 1.

An atomizing jet forces the mixture into the tube under low pressure. This finely atomized spray meets at right angles a stream of oxygen-free gases from an adjoining combustion chamber operating at 2,190-2,730 F.

Temperature in the reaction tube is between 1,110 and 1,290 F. After dehydration in less than 3 sec., hot reaction gases are quenched to approximately 120 F. by 30% phosphoric acid at the bottom of the tube. During quenching, the acid picks up water from the combustion gases and from the lactonitrile.

Major portion of this diluted acid from the quenching zone recycles for further quenching use. The remainder, reconcentrated, returns for mixing with the lactonitrile before dehydration.

► **Cleanup Steps**—Mixture of reaction gases leaving the reactor contains nitrogen originating from the combustion air, approximately 6% by volume of acrylonitrile, 2% hydrogen cyanide and 2% acetaldehyde.

Discharging from the reactor the gases pass through a venturi scrubber which removes phosphoric-acid fog. Passing into a tower, hydrogen cyanide and acetaldehyde in the stream contact lactonitrile wash, thereby forming more lactonitrile for recycle.

Next, the stream passes to a water scrubber for conventional separation of acrylonitrile. Waste gases discharge to atmosphere.

Extractive distillation removes acrylonitrile from aqueous solution. In the top of the stripper, gaseous acrylonitrile is washed with water to remove 0.5 to 1% acetonitrile. Leaving the stripper, crude acrylonitrile contains a slight amount of water, lactonitrile and 1-2% propionitrile. Recovered lactonitrile recycles to process.

► **Key Equipment**—For the critical dehydration, Knapsack plant uses a specially built, refractory-brick-lined, combustion chamber. Along with this is a 9.83-ft. by 16-in.-dia. reaction tube totalling 13.2 cu. ft. volume, not counting the quenching zone.

Throughput per liter of reaction-tube capacity is 100 gm./hr., roughly five times higher than that of a plant utilizing the catalytic acetylene process.

Both reaction tube and quenching zone are lined with Nicrotherm stainless steel.

In the U. S., KG's process for making acrylonitrile from acetaldehyde is offered for license through the newly formed Hoechst-Uhde Corp., Empire State Bldg., New York, N. Y.

Process paper presented this week before 5th World Petroleum Congress at the Coliseum, New York, by Dr. Sennewald, Knapsack Griesheim A. G.

Paraffin Extraction Gets Another Process

Add to Texaco's Selective Finishing process another route using molecular sieves to remove normal paraffins from hydrocarbon mixtures.

Universal Oil Products is now licensing a process tradenamed Molex which employs an undisclosed adsorbent in an isothermal fixed bed.

Molex, UOP explains, is not always preferred to fractionation of paraffins, but in many cases it's the only way to separate certain mixtures. And in one case, separating isobutane from normal butane, the choice between Molex and fractionation depends on such factors as concentration, capacity and product purity.

According to UOP, large amounts of normal paraffins (heptane and heavier) will be available as Molex byproduct. These constituents may well be of interest to chemical processors.

HOW *HERCULES* HELPS...

"CLEAN UP, PAINT UP, FIX UP"... Many of the nation's leading cities are currently observing "Clean-up, paint-up, fix-up" month. Hercules materials play an important role in the maintenance of homes and industrial buildings. Paints, thinners, disinfectants, cleaners, wallpaper are typical of finished products that depend on Hercules resins and other basic ingredients.

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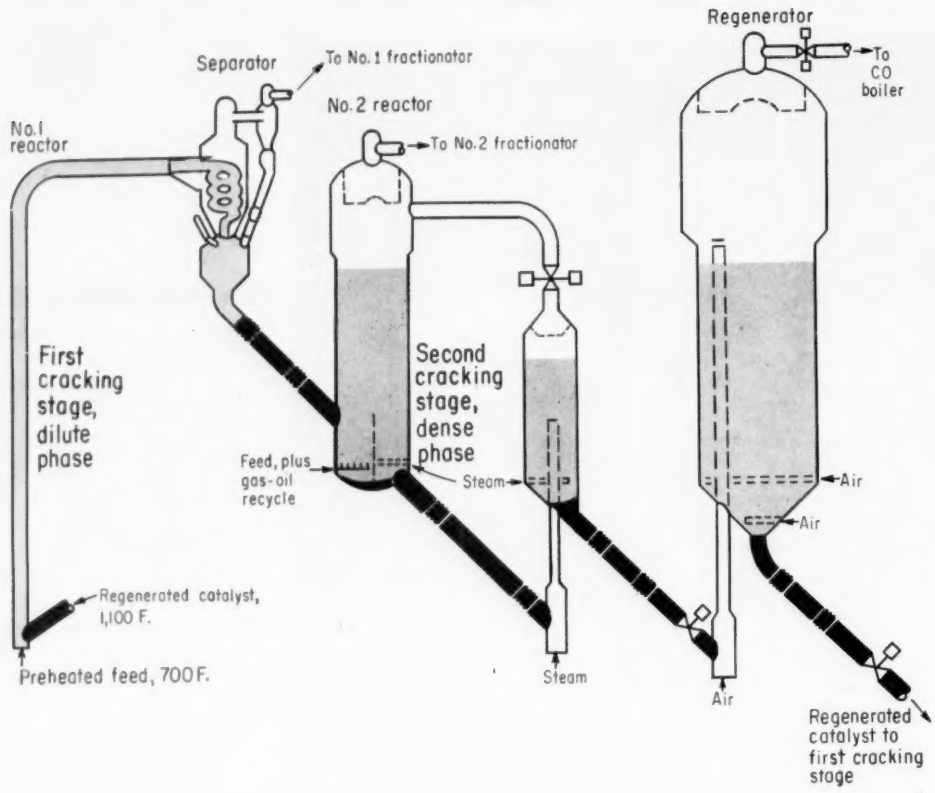
G59-3



Two-Stage Cat Cracking Proves Out

As demand for gasoline octanes and yields rises, two-stage cracking catches refiners' eyes, promises more profits.

Engineering evaluation of Shell Oil's two-stage catalytic cracker at its Anacortes, Wash., refinery has uncovered some valuable technical and economic observations.

In a paper given this week at the World Petroleum Congress in New York, Shell engineers describe their three years' commercial experience with such a unit and weigh the benefits of double- and single-stage cracking against the background of shifting economics and yield patterns.

Shell's major conclusions:

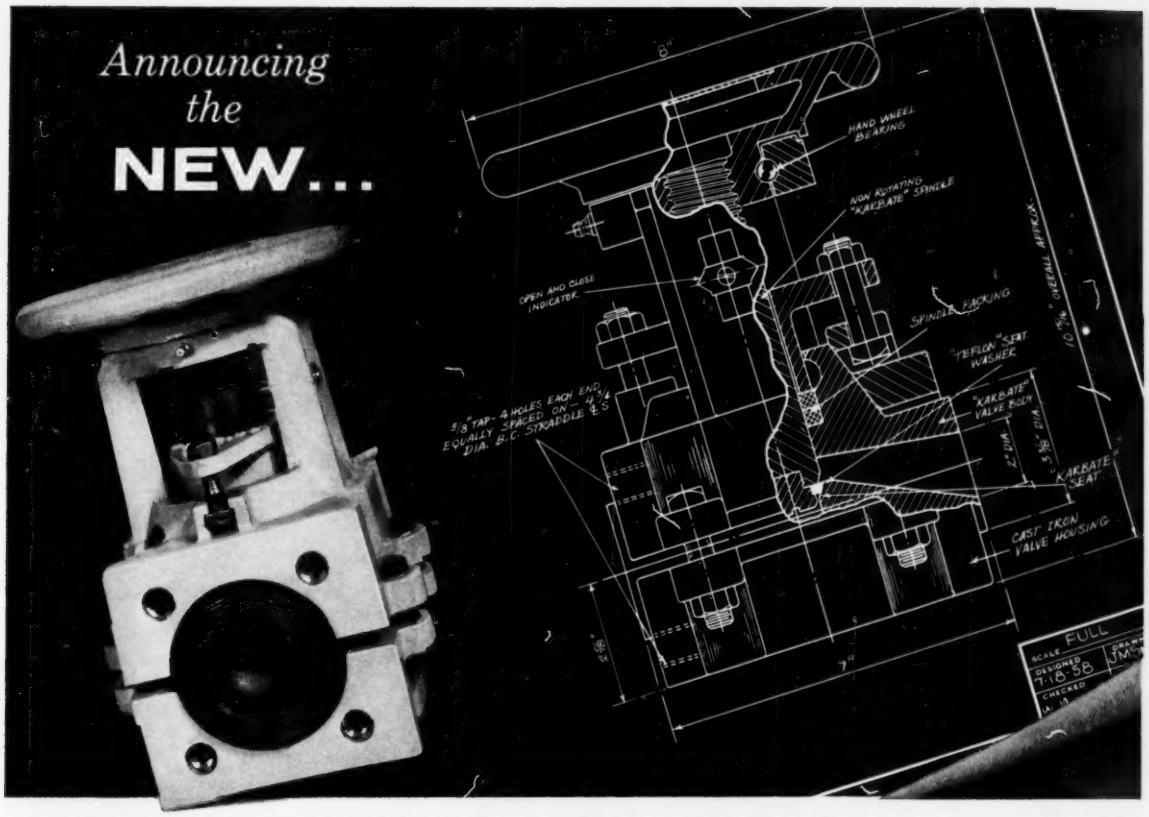
• Two-stage route becomes more profitable as gasoline-to-distillate production ratio increases and cat crackers are forced to operate at higher severity and conversion.

• Two-stage design helps retain valuable olefins in light gas stream and gasoline fractions, reduces slightly the amount of aromatics in effluent from cracking operation.

▶ **Two-Stage Setup**—Shell's unit (see diagram, above) consists of a riser reactor (total catalyst holdup of less than 3 tons, average catalyst density of less than 3 lb./cu. ft.), a dense-bed reactor (catalyst inventory ranging from 30 to 120 tons), two fractionators, a catalyst stripper and a regenerator.

Riser reactor, lined with hexsteel and refractory to reduce erosion, is sized for an intake of 23,600 bbl./day and gives 40-50% conversion. The lower 50 ft. is a straight vertical section, while the upper 75 ft. curves along an elliptical arc entering the number 1 separator horizontally.

Second-stage dense-bed reactor is designed to charge gas oils from the first stage along with a recycle stream to give over-all conversions of 63-72%. Unit has been run, however, at charge rates of 13,000-30,000



"KARBATE" GLOBE VALVE TYPE G

National Carbon Company announces the availability of a completely new "Karbate" impervious graphite globe valve. The many new design features of this valve were performance tested for approximately 1 year prior to adoption.

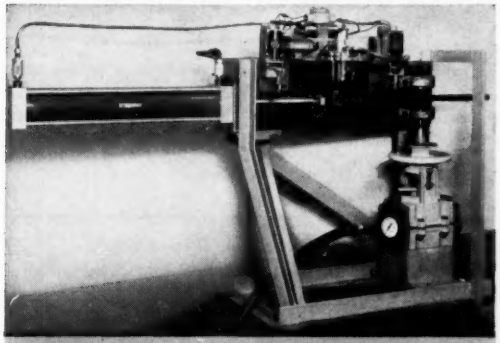


Photo shows test equipment for opening and closing valve to simulate years of actual plant operation. This set-up provided checks on the wearing qualities of spindle threads, sealing qualities of the "Teflon" plastic to carbon seat, and the leak-proof operation of spindle packings.

Principal design features:

- **"Teflon" plastic to carbon seat**—provides positive seal when valve is closed.
- **Metal handwheel to "Karbate" spindle thread design** — provides long operational life — no binding because of corrosion.
- **Non-rotating spindle**—simplifies spindle packing problem. Provides leak-tight seal using a variety of packings such as asbestos impregnated with "Teflon" plastic, braided "Teflon" plastic, asbestos impregnated with graphite and elastomers.
- **Lubricated ball-bearing handwheel to yoke arrangement**—provides easy movement of handwheel with positive lock to yoke.
- **Armored design**—prevents outside shock damage.
- **Positive indication of open and closed positions.**
- **Valve can be adapted to motor operation.**
- **Almost universal corrosion resistance**—can be used in a wide variety of corrosive chemicals. All wetted parts are "Karbate" impervious graphite or "Teflon" plastic.

Presently, this valve is available in the two inch size. One inch, one and one-half inch, three inch and four inch valves will be added to the line in the future.

bbl./day and total conversions of 65-90%.

Primary stage separator is a single, large cyclone, with efficiency of 99.4%, lined with silicon carbide bricks. Three parallel secondary cyclones, lined with hexsteel and refractory, recover catalyst fines and boost over-all recovery to 99.998%.

▶ **Process Flow**—Charge to the unit (heavy straight-run gas oils, deep vacuum-flashed distillates, deasphalted oil) enters the riser reactor at about 700 F., contacts regenerated catalyst at about 1,100 F. and the two materials (now roughly 1,000 F.) flow up the riser to the cyclone separator.

The combination of short contact time, high temperature and relatively high catalyst activity minimize secondary reactions of gasoline components which produce coke and gas.

Circulating catalyst is recovered in the cyclones and discharged to the second stage reactor. Here, gas oils from the first stage are further cracked in a dense bed. Number two reactor is kept at about 900 F. by recycling effluent gas oils.

Pressure in the riser reactor is maintained at about 10 psig. and in the regenerator, at about 16 psig. Balance between number 1 and number 2 reactors is achieved by applying back pressure with a butterfly valve in the number two reactor wet gas stream. Plant is designed as a heat-balanced unit without regenerator cooling coils. Catalyst circulation rate is used to heat balance the regenerator.

▶ **Yield Differs Widely**—To back its claim that the first stage reactor gives much improved yields of olefins, Shell lists these representative figures (yields in weight percent) for first and second stage olefin yields: First stage—ethylene, 0.6-0.8; propylene, 3.8-4.4; butylenes, 5.5-6.8; amylenes 3.7-4.8. Second stage—ethylene, 0.4-0.8; propylene, 2.3-3.4; butylenes, 3.2-4.0; amylenes, 2.1-2.4. Variations, in either case, are due to feed rate or other operating differences.

Shell believes that the characteristics of two-stage catalytic cracking are well adapted to meet present trends in refining toward more and better gasoline.

Comparative Economics of Cat Cracking*

Production of No. 2 Fuel Oil (bbl./day)

	12,700	13,950	16,650	18,750
Preferred type of cracking	2-Stage	2-Stage	2-Stage	1-Stage
Recycle pattern	Total gas oil	Combination	Heavy gas oil	Heavy gas oil
Combined[1] Feed ratio	2.1	2.0	1.9	2.4
Conversion[2]	79	76	70	60
Capital (million $)				
Cat cracking[3]	12.2	12.1	11.8	11.3
Total refinery	59.6	60.0	60.7	60.2
Gasoline cost[4] (¢/gal.) at octane credit:				
0.4¢/O. N.	13.04	12.99	12.84	12.92
0.2¢/O. N.	13.23	13.16	13.01	13.00

1. Volume ratio total feed to fresh feed.
2. 100 minus % by weight of product boiling over 450 F. cut point.
3. Includes gas plant but not offsite facilities.
4. Including capital amortized at 30% per yr. and including credits for octane number of pool above Research.

In comparing the economics of two-stage and single-stage cat cracking, Shell studied the two processes within the framework of a model refinery producing fuel gas, LPG, No. 6 fuel oil, housebrand gasoline, premium gasoline and No. 2 fuel oil. Further, Shell required that within this framework, both cracking processes operate for maximum profit, under conditions of conversion, temperature and recycle ratio to achieve this goal.

In this setup, two key determinants of over-all economics are demand for No. 2 fuel oil and credit assumed for octane numbers.

Economic criterion, then, is average gasoline cost, taking into account cost of raw materials and operation, estimated capital cost of refinery amortized at an assumed rate and credits for byproducts.

Calculation of gasoline cost was programmed for a computer and arranged so that input data regarding the cracking unit could be changed from case to case.

Results—Economic results tabulated above represent four favored operations taken from a plot of gasoline cost vs. No. 2 fuel oil demand, using two assumed values for octane number credit.

These results show that, for high fuel oil demand (above 18,000 bbl./day) single-stage cracking is preferred, with heavy gas oil recycle. At lower fuel oil production rates, two-stage cracking is preferred, the amount of fuel oil determining the type of recycle. At the lower end of fuel oil production range, preferred operation is with total gas oil to the second stage and total gas oil recycled in the second stage.

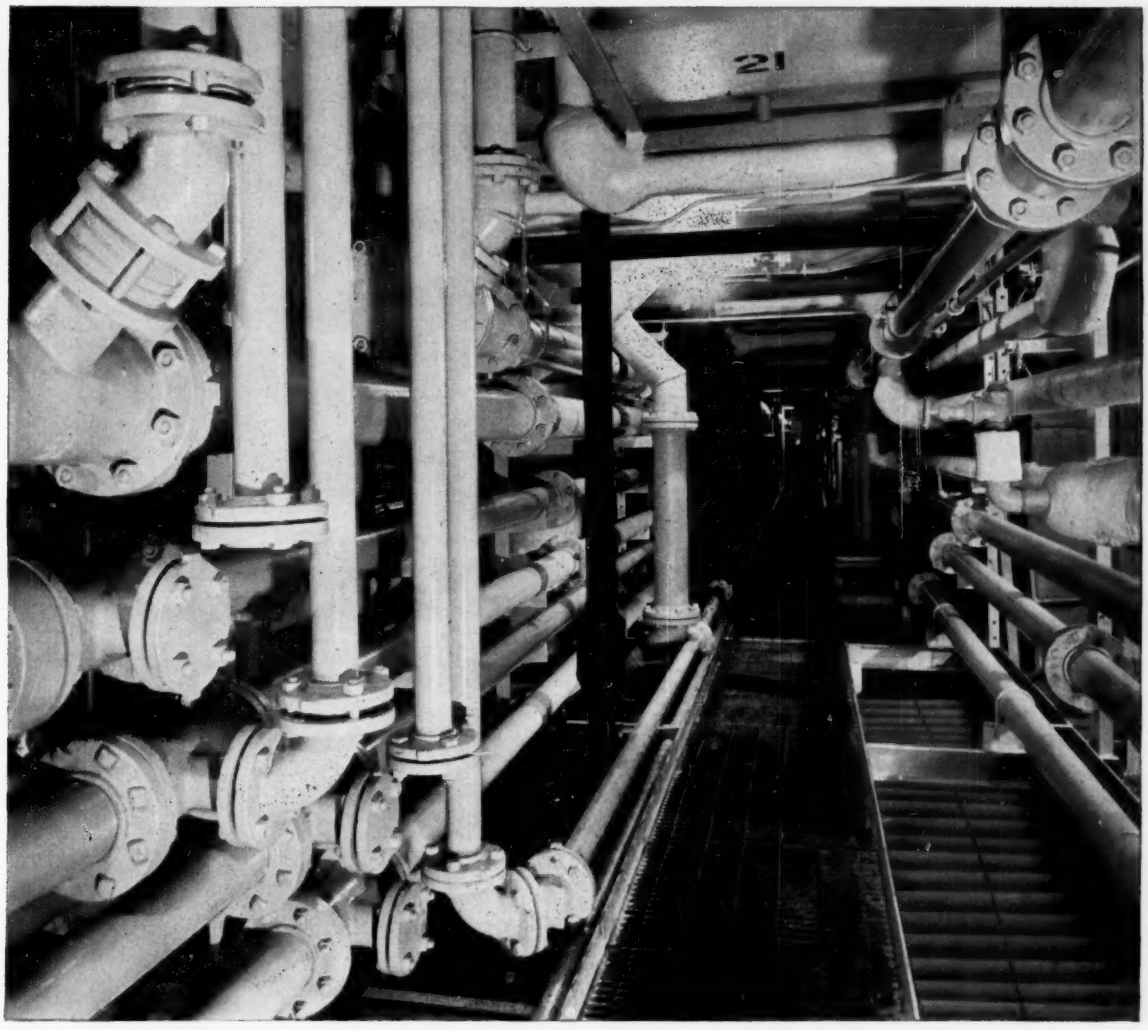
Results show that two-stage cracking is favored at the higher credit assigned to octane number. According to Shell, this means that two-stage cracking will become more profitable as octane levels become higher and more expensive to achieve.

* For a refinery making 30,000 bbl./day of total gasoline.

Homogenous Reactor Gives One-Step Superheat Steam

Homogeneous power reactor designed to produce superheated steam in a single step is undergoing tests at the Atomic Energy Commission's Los Alamos laboratory. Tests will determine the feasibility of reactor concept employing a solution of enriched uranium phosphate, phosphoric acid and water as fuel, relying on natural circulation of the solution to carry heat to the exchanger where steam is generated. Pressure vessel is 4 ft. high, 15 in. inside dia.

DOW | **SARAN LINED PIPE**



After six years of hot sulphuric acid . . .

Saran Lined Pipe still performs dependably

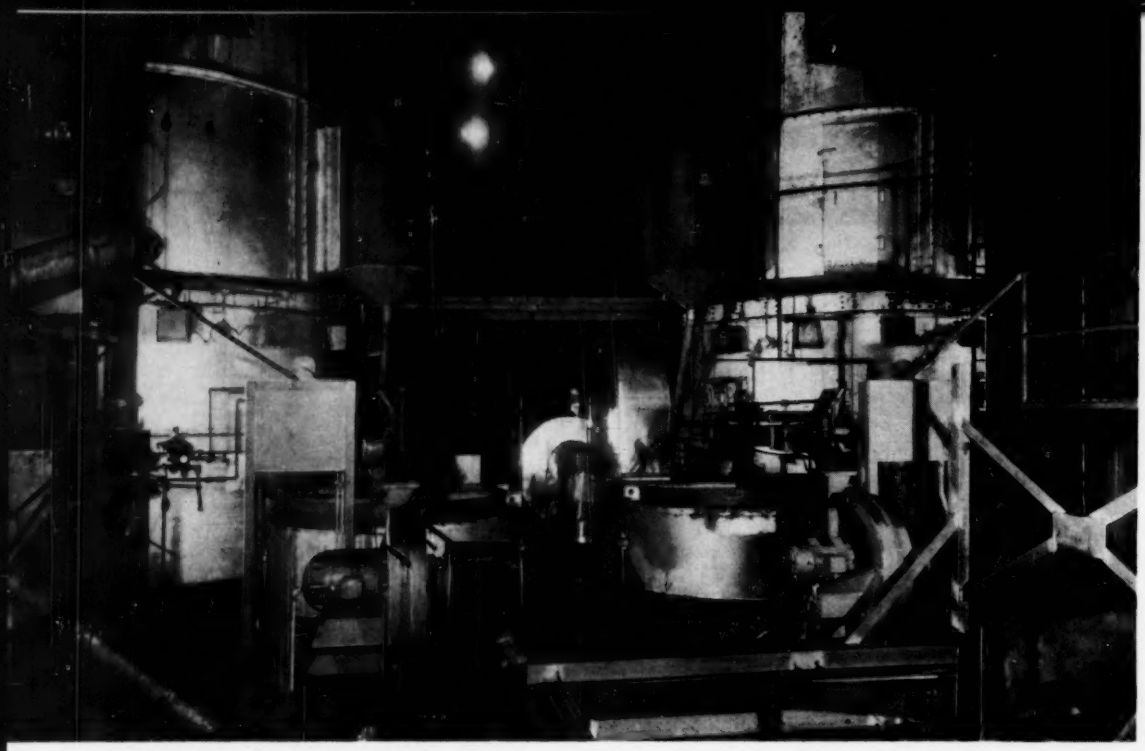
When 20,000 linear feet of pipe must carry a constant stream of hot sulphuric acid . . . when production requirements make pipeline failure intolerable . . . pipeline dependability is the lifeline of the plant. For the past six years, Saran Lined Pipe has carried dependably an unending flow of corrosive chemicals at Industrial Rayon Corporation's Painesville, Ohio, plant.

The installation shown above carries hot sulphuric acid and other chemicals used in Industrial Rayon's Continuous Process method of making tire cord. This Saran lined supply and return piping, serving all of the plant's spinning machines, carries the solutions from lower levels to spinning machines on the main floor. Pumping pressures range from 45 psi upward, and solution temperatures are above 125° F.

The Saran Lined Pipe was installed in 1953 and has been in continuous use since. Maintenance costs have been extremely low and I.R.C. engineers report that, during these six years, Saran Lined Pipe has performed dependably under their corrosive operating conditions.

Whenever dependable piping systems are required, whatever the degree of corrosion or chemical activity, consider Saran Lined Pipe. Saran Lined Pipe, fittings, valves and pumps are available for systems operating from vacuum to 300 psi, from below zero to 200° F. They can easily be cut, fitted and modified in the field without special equipment. For more information, write Saran Lined Pipe Company, 2415 Burdette Avenue, Ferndale, Michigan, Dept. 2282AK6-1.

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN



DRYER-COOLER-KILN UNITS have more than doubled rate of bone-char regeneration.

Integrated Kiln Leads Refinery Update

New integrated predryer-kiln-cooler brings major gains in modernization of sugar refinery that also includes other noteworthy engineering.

Up-to-date engineering practice is bringing new levels of efficiency to the venerable cane-sugar-refining process. Several outstanding examples are now contributing to operating economy and better product quality at Canada & Dominion Sugar Co.'s Montreal plant:

- Vastly improved heat economy and throughput with new efficient combination of louvered dryer integrated into multiple-hearth kiln and cooler for regenerating bone char.
- Modernization of affination step with modern, high-speed centrifugals to improve removal of surface impurities from raw sugar solids by heavy sirup.
- Switchover to rapid pressure filtration without inert filter aid through new CO_2 precipitation (defecation) that precipitates impurities in flocculent, easy-to-filter form.

▶ **Use Widens**—Two new dryer-cooler-kiln units at C&D have proved out so well that C&D will use one also in its new refinery now abuilding in Toronto. First use of such a combination was in Tate & Lyle's refinery at Liverpool, England.

And kiln manufacturer, Nichols Research & Engineering Co., is putting in these integrated units at American Sugar Co., Philadelphia, Pa., and at a big Mexican refinery.

▶ **Broad Gain** — One look at C&D's performance data tells why these units are winning favor. Present throughputs are 7.5 to 10 tons/hr. of dry char per kiln; before installation of the louvered predryers, a similar-sized kiln regenerated only 3 to 4.5 tons/hr.

Char economy has improved from 22 lb. required to clarify 100 lb. of sugar in the days of pipe kilns and old-style defecation to a present 11 lb./100 lb. of sugar. Credit for this 100% improvement belongs to better quality liquor from CO_2 defecation and to more effective decolorizing char coming out of new regenerator setup.

Char loss, a most critical issue in carbon regeneration, runs about 0.5% of dry char throughput per cycle. All of this is attributable to dusting, none to rejection of substandard char.

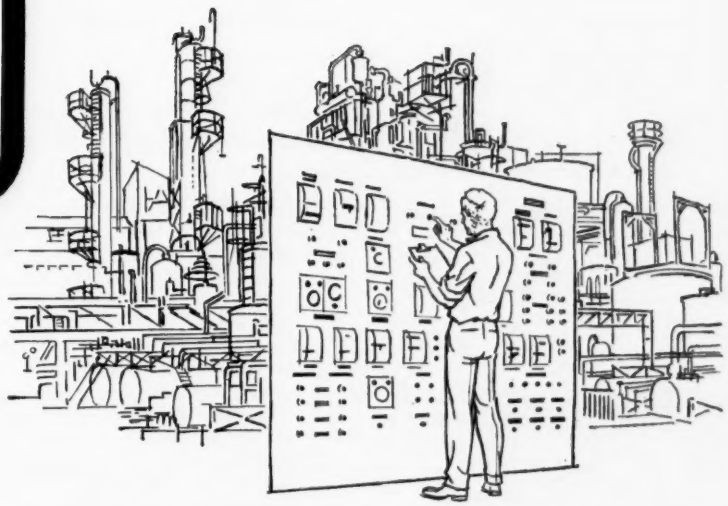
whatever the **chemical process application . . .** you can depend on **CUNO** engineered filtration

Whether you are working with acids, alkalis, solvents, or reactor gases . . . paints, pharmaceuticals, soap or any of a myriad of products which fall within the chemical process field . . . filtration is essential.

This broad scope of applications has resulted in the need for a wide variety of filter types. Cuno offers you a *complete* line to answer the specific requirements of any process application:

- positive self-cleaning edge-type
- automatic self-cleaning wire wound type
- disposable depth cartridge type
- porous metal type
- screen mesh type

Whenever *you* have a filtration problem, write us. Our engineers will welcome the opportunity to demonstrate how you can *depend on* CUNO.



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In Canada: Peacock Bros., Ltd., P. O. Box 1040, Montreal 3, P.Q.

▶**Tops It Off**—How C&D's regenerator is integrated reveals why the refinery gets such effective heat economy. Sitting atop the Herreshoff kiln, the dryer draws its hot-air supply through a central air shaft connecting to char cooler under the kiln.

Louvers in the dryer are positioned in an unusual, compact, radial arrangement around the central air shaft. Air discharges into chamber around dryer.

Continuous char drawoff is considered very important. It keeps the char in motion in the dryer, assuring even flow of char through each dryer leaf. This, in turn, equalizes resistance to air flow through the dryer and minimizes pressure drop.

Performance characteristics of the louver dryer enable it to dry char from 20% entering moisture content down to 1% moisture. Drying rate runs about 20 lb./(hr.)(sq. ft.) of drying surface with air entering at 290 F. and leaving at 120 F.

▶**First on Continent** — Downstream from the affination, C&D defecates its sugar liquor with lime and washed flue gas containing 9-10% CO_2, a major departure from lime and phosphoric acid commonly used in the U. S. Believed to be first in North America to use this European technique, C&D feels that it is better than phosphate defecation. But, capital cost is higher.

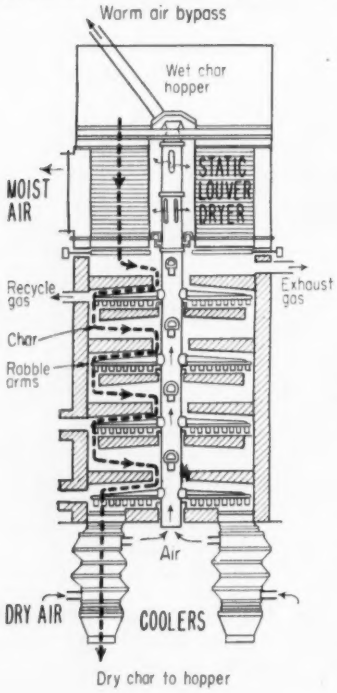
Operation starts with liming of liquor to pH 10, equivalent to 0.4-0.7% CaO based on liquor solids. Flue gas introduced to each of three saturator tanks connected in series drops alkalinity of the liquor to pH 8.5.

Decrease in pH, under carefully controlled conditions, forms flocculent calcium carbonate precipitate which carries precipitated gums, colloids and insoluble impurities down with it. These solids are readily filterable without filter aid.

Gas flow at a raw-sugar rate of 100,000 lb./hr. is 1,500-1,800 cfm. for total contact time with liquor of 60-90 min. Liquor enters process at 140 F., is heated to 185-190 F. in last tank. To assure uniform precipitate for good filtration it is essential to control liquor viscosity closely.

Precipitation is carried to 75% completion in first saturator. Gas containing less than 8% CO_2 is not recommended. Otherwise, higher gas flow makes control more difficult, boosts evaporation losses and pumping costs.

Louver dryer atop kiln predries wet char feed



Shale Deposit Locks Up Nuclear Waste

Over a six-year period, Oak Ridge National Laboratory has drained 11 million gal. of radioactive waste in local shale formations without polluting nearby sources of water and food. So reported W. J. Lacy and D. G. Jacobs before the 135th national meeting of the American Chemical Society, recently.

Apparently, radioactive particles in the waste solution become adsorbed on the illite and montmorillonite clay present in the Conasauga shale formations at Oak Ridge, Tenn. "Based on the maximum permissible concentration values for water recommended by the International Commission on Radiological Protection, the shale is 98% effective in reducing the hazard," reports Lacy.

Even though holding such hazardous fission byproducts as radioactive cesium and strontium, the shale has not leaked any of these materials to surrounding test wells and plant life. "If the seepage pits draining into the shale are withdrawn from operation before all the shale is saturated, there is little danger of cesium being displaced into surface drainageways," says Dr. Jacobs.

Chlorine Is Poison for Redwood Cooling Towers

Chlorine appreciably accelerates the attack of fungi on redwood cooling towers. This is the conclusion reached by recent research studies confirming previous findings of the California Redwood Association. Earlier reports of the CRA suggested that adding small amounts of chlorine to combat algae in circulating cooling water reduced the wood's ability to resist biological attack.

New studies at the Forest Products Laboratory in Madison, Wis., found that fungi isolated from badly rotted cooling towers would only attack softwoods after the lumber was leached with sodium hypochlorite solution. "Evidence indicates that chlorine appreciably accelerates attack on softwoods by organisms of the soft-rot type," says the laboratory's C. G. Duncan.

Independent studies made in Britain show that soft-rot fungi will not grow on coniferous woods unless the wood samples are first treated with chlorine water. Copies of CRA's study on cooling tower maintenance may be obtained by writing to the Technical Div., California Redwood Assn., 576 Sacramento St., San Francisco 11, Calif.

Vapor Fractometry Probes Flavor Secrets

Even the sacred and secret art of flavors is feeling the merciless probing of scientific analysis.

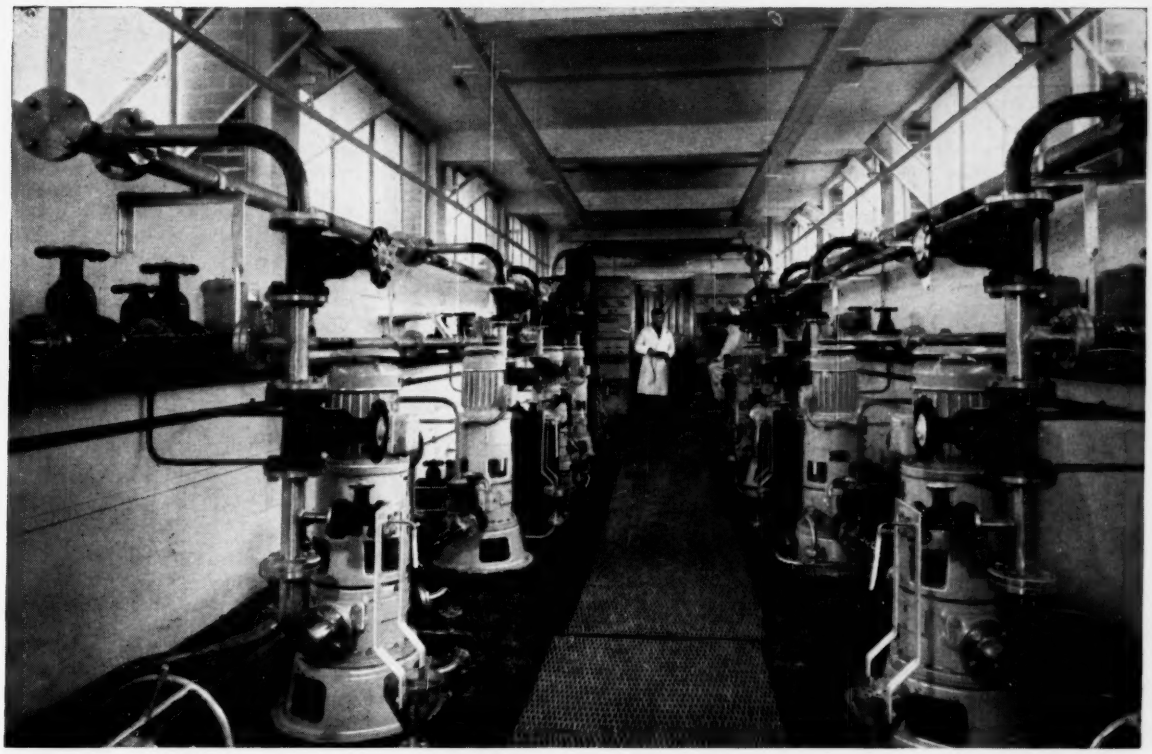


Photo by courtesy of the United Kingdom Atomic Energy Authority

LaBour Pumps Handle Tough Atomic Energy Jobs

The LaBour Type G Packingless Pumps in the picture are part of more than 250 LaBour Pumps in this one establishment of the United Kingdom Atomic Energy Authority. Where the job is difficult, or where failure of a pump can be especially costly or hazardous, you are likely to find LaBour Pumps on the job. British engineers, like those in the rest of the world, know that when you can't afford to take a chance you take a LaBour.

The pumps in the photograph were built by British LaBour Pump Company, Ltd., in London. In every essential respect, including the carefully controlled casting of corrosion resistant alloys and the final performance check before delivery, they are identical with American-built LaBour Pumps.

British or American, LaBour means dependability in pumping service—and the dependable pump is always the economical one, too. We'll be glad to show you what a LaBour Pump can do for *you*. Just ask us.

ORIGINAL MANUFACTURERS OF THE SELF PRIMING CENTRIFUGAL PUMP

LABOUR

THE LaBOUR COMPANY, INC. • ELKHART, INDIANA, U. S. A.

Armed with a vapor fractometer, Robert Carroll, chemical consultant of Greenwich, Conn., and Lawrence C. O'Brien of Norwalk, Conn., have identified ten trace constituents contributing taste and aroma to whiskies.

Reporting their findings before the 135th national meeting of the American Chemical Society, Carroll and O'Brien feel that ultimately it may be possible to produce synthetic beverage identical in every respect to the best products available. By eliminating aging and storing, considerable time and cost could be saved.

Correlation of analytically determined volatile components with findings from a taste-and-flavor panel should provide new insight into product flavor and aroma. Then, the analytical method can make it possible to produce and market an extremely uniform product.

Present work will be extended to analysis of the low-volatile components of alcoholic beverages. And the technique is being applied to other aroma problems such as tobacco smoke and coffee.

Tungsten Enters Lists As Construction Metal

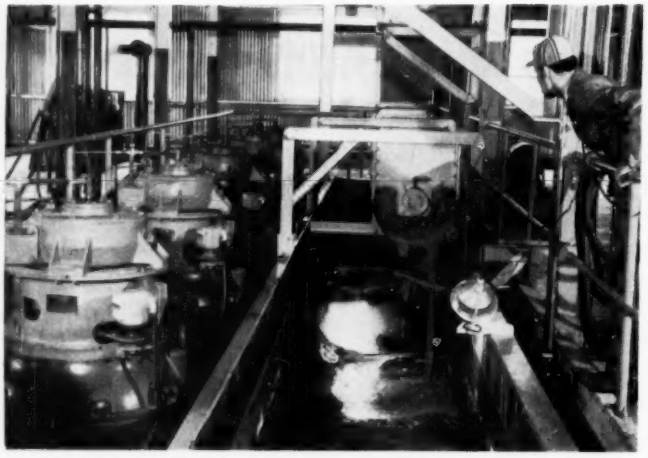
Fansteel Metallurgical Corp. is making a strong bid to enter tungsten in the race among materials of construction for the demanding high-temperature applications of the space age.

Company recently announced that it has developed techniques for previously impossible jobs of forging, hot extruding, deep drawing and spinning this tough, high-melting-point metal. As a product of powder metallurgy, tungsten has been practically impossible to work or fabricate into other than relatively simple shapes prior to Fansteel developments.

First market score for the breakthrough, reports a company spokesman, is a small spun-tungsten rocket nozzle already tested by a West Coast aircraft manufacturer. But Fansteel is seriously considering the prospects of wrought-tungsten process equipment such as heat exchangers and reactor liners.

Breakthrough in tungsten fabrication was spurred chiefly by rapidly shifting emphasis in materials development from one of cost to one of performance. Although the wrought-tungsten products are four to five times as expensive as competing materials, they are standout materials for punishing operating conditions. Tungsten has the highest melting point of all metallic elements (6,152 F.), is the strongest and one of the most dense.

Fansteel characterizes its development as having now emerged from the pilot-plant stage.



Automation Updates Another Sugar Refinery

Another sugar refinery recently began reaping the benefits of the incipient automation age: Imperial Sugar Co. at its Sugar Land, Tex., refinery. (See story on Canada & Dominion's Montreal refinery beginning on p. 50) Imperial's refinery, processing 2.5 million lb./day of raw sugar, now has an automatically controlled affination setup, part of which is shown above. Picture shows magma, a thick mixture of raw sugar and affination sirup, dropping into a mixer which feeds centrifugals, left.

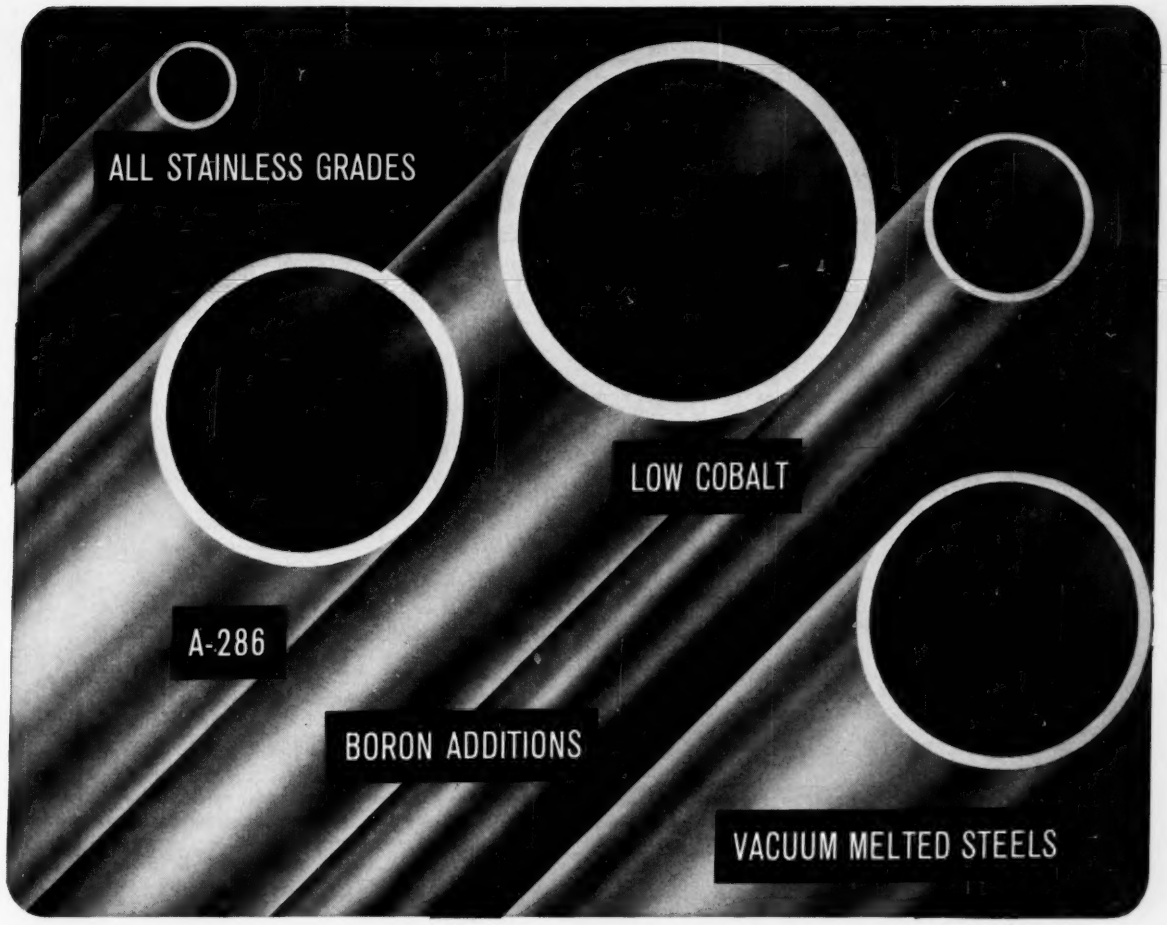
NEWS BRIEFS

Alkylated aromatics: Universal Oil Products unveiled its new Alkar process at the recent AIChE meeting in Kansas City, Mo. Using a wide range of feedstock, process alkylates aromatics over a fixed-bed catalyst.

Nuclear power station: Britain's Central Electricity Generating Board plans construction of a 1-million-kw. nuclear power plant on the Severn River in southwest England. Cost-saving feature of location is a rock shelf off shore, which plant will use as reservoir for cooling water at low tide.

Secondary alcohols: Soviet scientists have reportedly produced secondary alcohols by oxidation of liquid *n*-paraffins at 280-305 F. in an N_2-O_2 mixture in the presence of boric acid.

Experience *— the added alloy in* **Allegheny Stainless**



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A-L offers widest range of materials and large diameters with walls as thin as .032".

Here is the widest range in materials in stainless seamless tubing available anywhere to meet your exact requirements and solve high-temperature or corrosion problems and save you money.

Allegheny Ludlum makes seamless tubing in all stainless grades including 309, 317, 318, 310, 416 and 446—normally difficult to obtain. Also available in high-strength alloys such as A-286, in vacuum melted steels, and in custom analyses grades such as low cobalt with .01 or .05 max. and small boron additions to standard types.

A-L also makes composite tubes with bonded combinations of carbon and stainless and other metals for special chlorine-corrosion applications in process equipment.

Allegheny Ludlum Stainless Tubing ranges from 3/16" OD to 3½" OD with wall thickness ranging from .013" to .375"—typical of the sizes that A-L can produce. For certain applications, .500" walls are possible. Some standard sizes in stock are 2½" OD—.032" walls, 3" OD—.042" walls and 3½" OD—.042" walls and 3½" OD—.058" walls. All sizes with true circularity, no dents or handling marks.

A-L Tubing is also available in small quantity orders, in random or cut lengths. Standard grades and sizes in stock throughout the country. Call your nearest A-L representative for all the help you need.

Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa. Address Dept. CE-18.

NEW! FREE—Write for your copy of Allegheny Ludlum Stainless Tubing—32-pages of technical data, grades and suggested applications.

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"OK, I'll buy. But I'm keeping an eye on the part of our plant that's still idle."

CPI Warily Steps Up Capital Spending

Chemical processors are slow to build new plant while old plants gather dust. Look for big sales to change their thinking.

William H. Chartener, McGraw-Hill Dept. of Economics

Capital expenditures are climbing again in the chemical process industries. Plans for new plants and equipment for 1959-62 are already higher than 1958 spending. And the chemical industry itself expects a steady year-to-year rise in capital outlays.

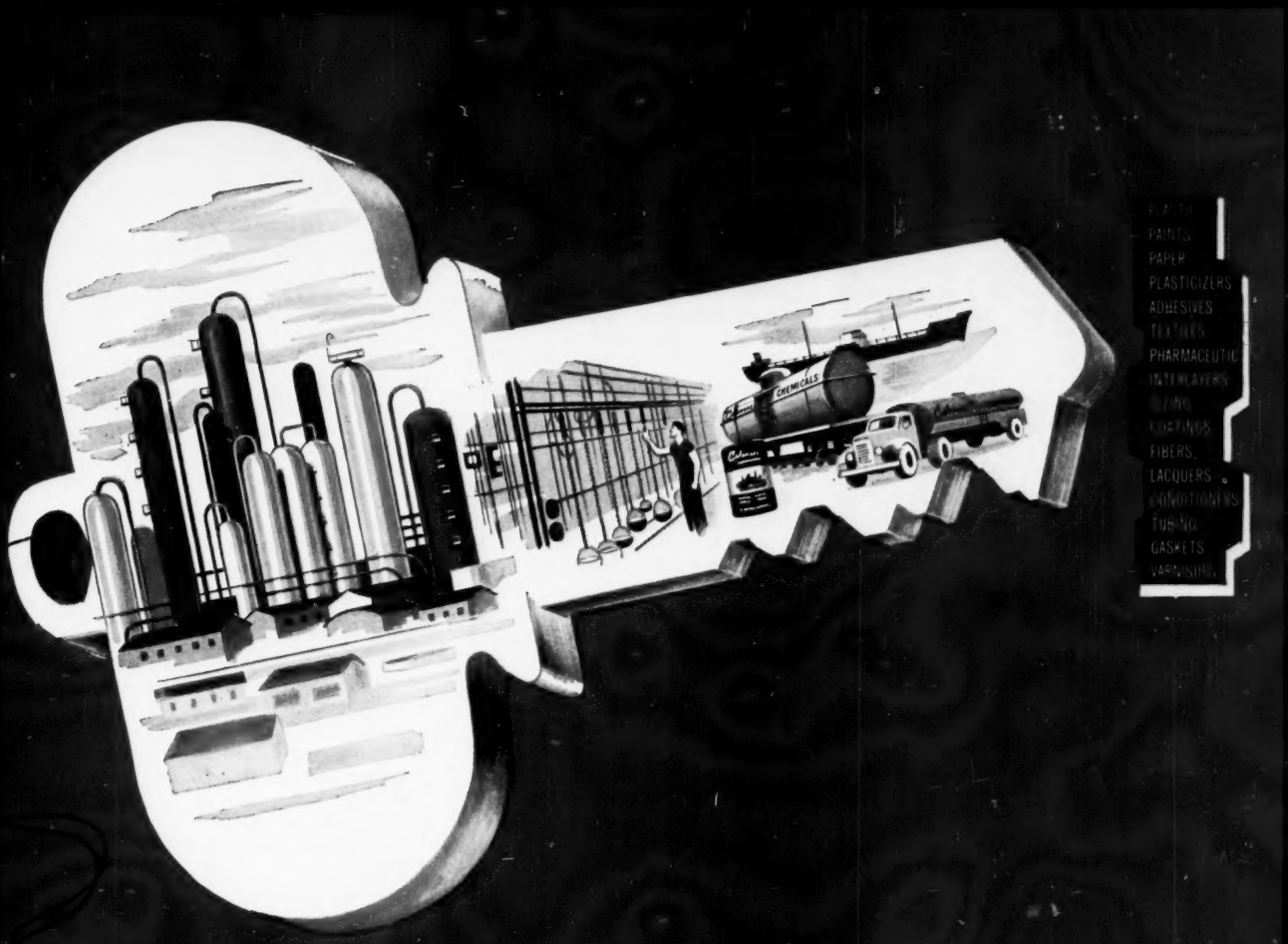
But there is none of the boisterous quality of the headlong dash to build new plant during the boom years of 1955-57. Present plans still fall far short of peak levels attained in 1956 or 1957, except in the rubber industry which expects to top its 1957 peak by 1961 or 1962.

Chemical processors' desire to spend more on capital goods is very genuine and more fervent than just six short months ago. Their zeal is tempered, however, by the cold hard facts of sizable productive overcapacity in nearly every major chemically processed product.

▶ **Eyes Open**—They'll be carefully watching sales in the next few years. If sales increases are far enough ahead of capacity increases to force operating rates near preferred levels, then we'll be seeing another capital goods boom that could rival the one in the mid-1950s.

Actually the gap is already narrowing. Continuing improvement in business may wipe out overcapacity and bring new peaks in investment.

▶ **Optimism Grows**—New plans for capital spending, just reported in the 12th annual survey conducted by the McGraw-



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We make the raw materials for vinyl acetate and combine these materials to form the monomer. We exercise control of all the processes basic to the finished product. Result: you benefit when you buy high-quality $CH_3CO_2 \cdot CH{:}CH_2$ monomer from the Celanese Corporation of America. With a reliable monomeric product as a start, you can take the next steps with confidence:

Polymerize Celanese vinyl acetate to produce adhesives, binders, coatings, water-based paints, primers and sealers.

Make copolymers for products such as industrial cloths, flexible sheetings, films, rigid panels, and extrusion and molding compounds.

Use the monomer as an intermediate to prepare pharmaceuticals and fine organic compounds. Write for the technical data on Celanese vinyl acetate monomer today.

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Canadian Affiliate: Canadian Chemical Company Limited, Montreal, Toronto, Vancouver.
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Celanese®

Hill Department of Economics, show substantial increases in spending plans since McGraw-Hill's check-up on preliminary plans last fall. At that time, the chemical industry expected to spend 8% less this year than in 1958; now it plans to boost capital outlays by 5% over last year's recession level.

These are some of the other highlights of the new McGraw-Hill survey:

• In the chemical process industries, and throughout manufacturing, there will be heavy emphasis on updating obsolete plants and equipment in the years 1959-62. U.S. industry will spend more on modernization this year than in any previous year.

• Chemical companies look for a sharp snap-back in sales this year and a continued strong rise between 1959 and 1962.

• Despite present unused capacity, chemical and other process industry companies plan further expansion between now and 1962. But, except for paper companies, they expect sales-to increase faster than capacity and to take up some of the slack.

• Research outlays rose sharply last year, during a severe recession, and will continue to increase.

• Industry is in a strong financial position to support increased outlays for plants and equipment, as depreciation allowances will be rising steadily. The chemical industry expects depreciation to be running nearly 20% higher in 1962 than in 1958, and other process industries expect an even greater rise.

• Most CPI companies say they would boost their spending plans further if the tax law allowed them substantially greater depreciation allowances.

▶ **Wet Blanket** — Main factor holding capital expenditure plans below 1957 levels is the cushion of unused capacity in every manufacturing industry. At the end of 1958, manufacturing companies were operating at only 80% of capacity. In earlier McGraw-Hill Surveys, they have indicated that, on the average, they prefer to operate at about 90% of capacity.

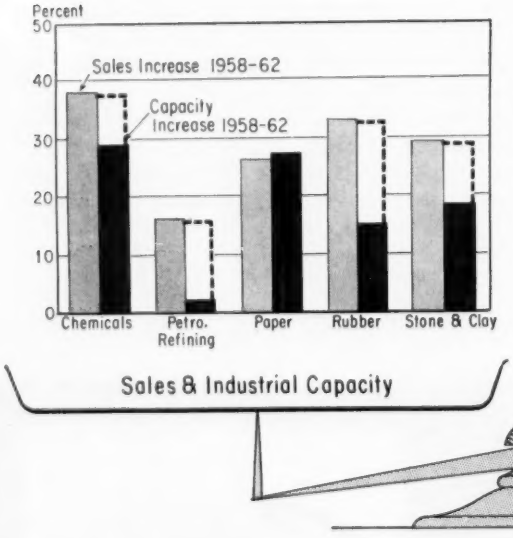
Because of the nature of continuous process operations, CPI companies as a rule prefer even higher operating rates. In all five process industries, operations at the end of 1958 were several points below preferred levels (see chart this page).

As production has increased since the turn of the year, these operating rates are undoubtedly higher now. Moreover, chemical companies—despite the huge expansion programs of recent years—reported an operating rate for the end of 1958 (80%) that was higher than at the end of 1954 (79%), when business was recovering from an earlier recession.

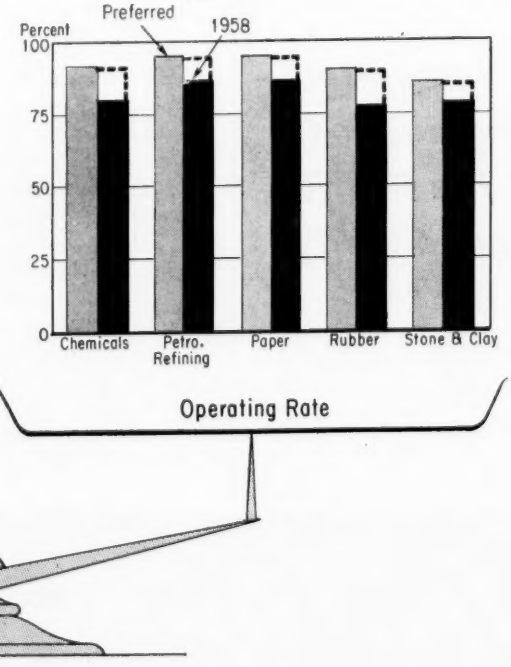
▶ **Closing the Gap**—It is clear from sales forecasts that chemical companies expect to narrow the gap of unused capacity. They expect an 11% sales increase this year, while capacity

Another Capital Boom Hangs in the Balance

How soon can accelerating sales . . .



. . . cancel our unused capacity?



Which of these 3 products and services can you use from BECCO?

What's new in Metal Treatments and Etching?

Quite a few things. For example, there's the use of Becco Ammonium Persulfate in etching printed circuits. Seems the material works a lot better – at less cost – and with none of the hazards of the ferric chloride solutions conventionally used.

Then, there's the problem of pickling copper and brass. Lots of pickling agents will do this – only trouble is, you've got to paint or plate or do whatever you're going to do with the metal rather quickly. Or else. Or else it will tarnish or oxidize and you're in the pickle all over again.

Not so with Ammonium Persulfate. Cleans fine. Puts a mild etch on the surface, too, for better paint or plating bonding. More important, perhaps, is the fact that the metal resists retarnishing for up to two weeks. Ideas?

We hope so. What's more, we've got several booklets to help spur you on. They're free–use the coupon below to order.

No. 39 and 51–Surface Treatment of Metals with Peroxygen Compounds.

No. 86 – Improving Properties of Copper and Brass Surfaces.

No. 97 – Paddle Etching of Printed Circuits with Ammonium Persulfate.

No. 99 – Tank Immersion Etching of Printed Circuits with Ammonium Persulfate.

No. 102–Etching of Printed Circuits with Mercury Activated Persulfate.

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BECCO CHEMICAL DIVISION, FMC
Station B, Buffalo, New York

Dept. CE-E

Gentlemen:

Please send me the following free bulletins:

☐ 39 and 51 ☐ 86
☐ 97 ☐ 102 ☐ 99

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What's a PEROXYGEN?

Fact is, "peroxygen" is a word that Becco uses to indicate that we can tie oxygen onto just about anything.

How come? Well, years of experience in producing Hydrogen Peroxide has produced an affinity between Becco and oxygen — an affinity we have capitalized on to give you compounds that will provide a ready source of oxygen — wherever, however and whenever you need it.

We have a good number of such compounds on the shelves. Quite a few others are in development. Still others are merely in our minds, but we can begin drawing them out if you're interested.

We hope you are interested. But we'll never know—unless you fill in the coupon below and mail it to us. Why not?

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Send me more information about Becco Peroxygen Chemicals.

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Problems in handling Hydrogen Peroxide

Becco's Four-Fold Engineering Service Program—offered free —includes:

1. Comprehensive survey of your facilities.
2. Specific proposal with recommendation of proved equipment and where it is obtainable.
3. Installation supervision by Becco.
4. Periodic inspection and permanent service.

Can you use this free Becco help, based on more years of experience with bulk handling of H_2O_2 than any other manufacturer? Use the coupon to let us know.

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Gentlemen:

Please tell me more about your Four-Fold Engineering Service.

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will rise only 8%. And they look for a further sales increase of 24% by 1962, while capacity is scheduled to rise 19%.

Sales will also rise relative to employment, which means that chemical companies anticipate sizeable gains in productivity. They expect their employment to increase only 2% this year and another 7% by 1962—only about one-fourth as much as the expected sales increase over the period 1958-62.

Expansion plans vary widely in other process industries. Petroleum refining companies plan only a 1% capacity increase this year and another 1% by 1962. But paper and pulp companies plan a 7% increase in 1959 and 19% for 1959-62.

Expected increases in employment this year range from 2% (in petroleum refining and paper and pulp) to 6% in the stone, clay and glass industries. Between 1959 and 1962, the petroleum refining and paper and pulp companies expect a further employment rise of 4%, while rubber companies expect to add 9% more workers.

▶ **No Brake on Research**—One of the most important economic developments of 1958 was the decision of industry to hold firm on plans for expanding research and development. This means for the future a continuing flow of new products and processes, and a continuing need for new facilities to take advantage of them.

Every one of the process industries actually spent more on R & D in 1958 than the plans reported to McGraw-Hill last spring. Increases over 1957 spending ran from 7%, in the case of chemical companies, to 13%, in the rubber industry. Substantial increases on top of present programs are planned for the years 1959-62.

The paper and pulp industry reported plans for one of the fastest increases in research outlays of all manufacturing industries. By 1962, paper and pulp companies expect to be spending $71 million a year on R & D—a third more than in 1958.

▶ **Research Hardware** — This year's McGraw-Hill Survey includes, for the first time, information on capital expenditures for research facilities. The chemical industry ranks first of all manufacturing industries in dollar outlays for research facilities—$111 million in 1959, or 8% of its total plant and equipment expenditures.

The ability of industry to carry out its present capital spending programs—and even to increase them—is indicated by data on the flow of funds from depreciation. This has become the largest source of corporate funds for plant and equipment, and it will be increasing over the next four years.

▶ **Depreciation Reserves High**—Last year, chemical companies had a total of $1,065 million in depreciation allowances—enough to cover 80% of their capital expenditures. Even with a steady rise in spending plans, their flow of funds from depreciation will amount to almost 80% of outlays in 1962.

In the rubber industry, the flow of funds from depreciation is already higher than planned expenditures. And in the stone, clay and glass group, it is expected to top capital spending—beginning in 1960.

The prospect of a substantial increase in depreciation funds should bolster spending plans in the years ahead, for most companies in the past have said they make it a practice to spend all their depreciation on new plants and equipment.

▶ **Liberalization Would Help**—Companies participating in the McGraw-Hill Survey reported they would invest even more in new facilities if depreciation allowances permitted under the tax law were substantially increased. In the CPI group, well over half of all companies said higher capital spending would be the principal effect on their own financial policies of liberalization of tax provisions on depreciation.

Process Industries Beef Up Research Budgets Again . . .

(Million Dollars)

	1957	1958	1959	% Increase 1958–59	1962	% Increase 1959–62
Chemicals	568	607	638	5	752	18
Petroleum refining	231	259	296	14	328	11
Pulp & paper	48	53	57	8	71	25
Rubber	76	86	95	10	112	18
Stone, clay & glass	64	71	79	11	91	16
All mfg.	**6,935**	**7,818**	**8,650**	**11**	**10,178**	**18**

. . . and Back Capital Budgets With More Dollars

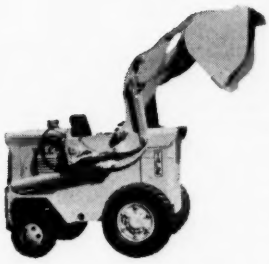
(Million Dollars)

	1957*	1958*	1959	1960	1961	1962
Chemicals	1,724	1,320	1,386	1,441	1,542	1,635
Petroleum refining	853	665	698	670	750	765
Pulp & paper	811	578	636	617	611	587
Rubber	200	134	165	188	203	223
Stone, clay & glass	572	399	498	469	478	486
All mfg.	**13,647**	**9,761**	**10,472**	**10,448**	**10,265**	**10,444**

* U. S. Dept. of Commerce, Securities and Exchange Commission, McGraw-Hill Dept. of Economics.

10 hours' work in an 8-hour shift!

That's the production advantage of the Yale Industrial Tractor Shovel



Here are the features that make the Yale Industrial Tractor Shovel outstanding...

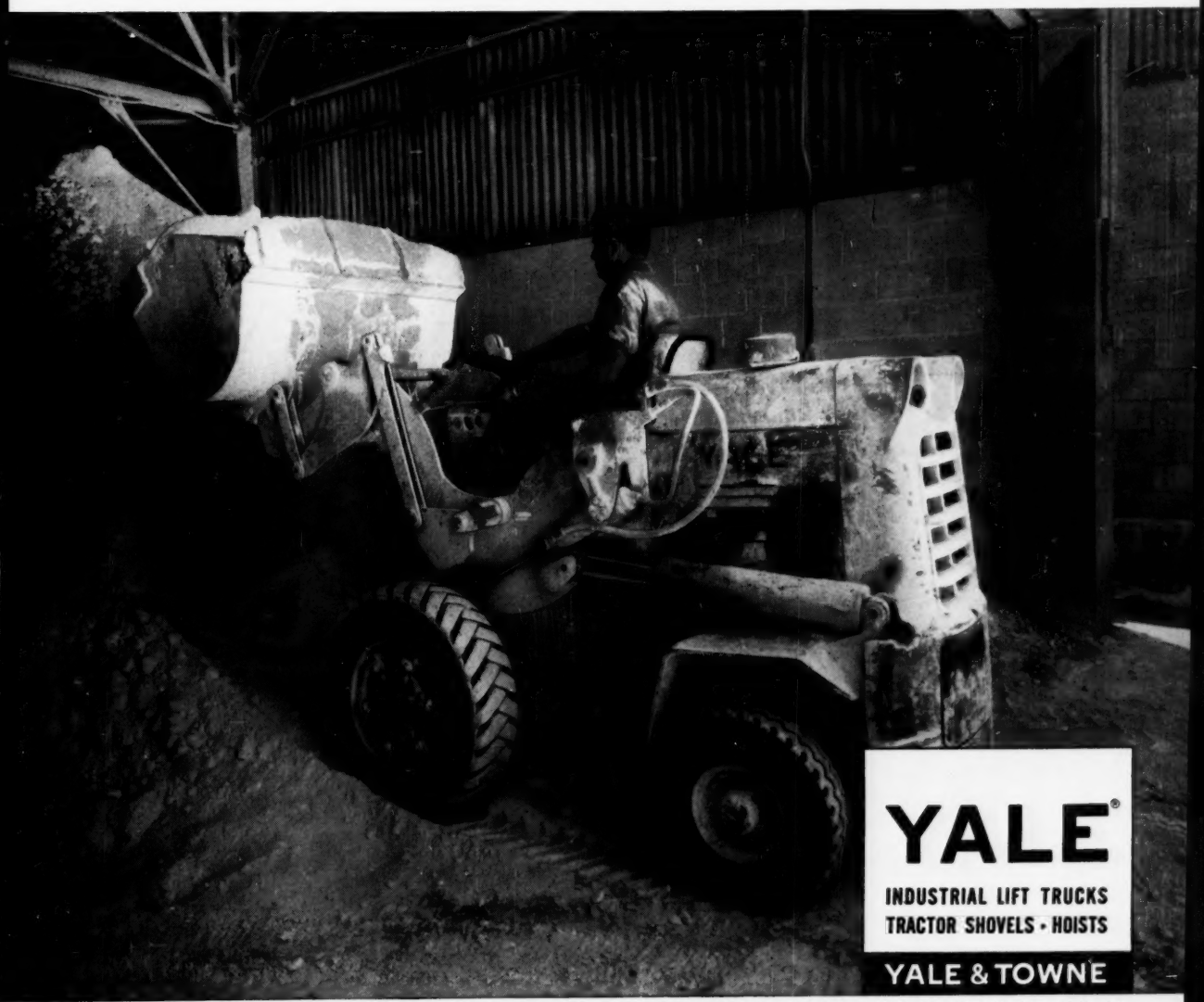
PRECISELY CONTROLLED HORSEPOWER! 72 hp. 6 cylinder engine provides smooth power through matched torque converter and Yale torque transmission (fully automatic). One speed in both directions. Inching control permits delicate close-quarter maneuvering. Extra punch for impact loading. Accelerates to 13 mph. in 5½ seconds.

PERFORMANCE! 2500 lb. carry capacity. Exclusive 45° bucket tipback permits faster loading and lowest carry position for faster transport with minimum spillage. 6' dumping clearance permits dumping into bins and hoppers out of range of other—even larger—tractor shovels. Shortest turning radius, too—only 73".

SAFETY! Safety-curve lifting mechanism members never rise alongside the operator. Front and back working lights provide extra security.

DEPENDABILITY! Rugged design • sealed brakes and electrical system • protected steering linkage • 10 ply tires—all adds up to more work at less cost...more production hours. Full range of buckets and attachments available.

Field applications prove that these features add up to 25% more work per hour—10 hours' work in an 8-hour shift. For a demonstration in your plant or complete information contact your Yale representative. Or write The Yale & Towne Mfg. Co., Yale Materials Handling Division, Phila. 15, Pa., Dept. YT 2-V.



Yale Materials Handling Division, a division of The Yale & Towne Manufacturing Company. **Manufacturing Plants:** Philadelphia, Pa., San Leandro, Calif., Forrest City, Ark.
Products: Gasoline, Electric, Diesel and LP-Gas Industrial Lift Trucks • Worksavers • Warehousers • Hand Trucks • Industrial Tractor Shovels • Hand, Air and Electric Hoists

ECONOMICS . . .

Inflation Is Everyone's Responsibility

Everyone talks about inflation but, unlike the weather, everybody does something about it, too. We're all busy—every last one of us—wanting what we want when we want it, and reaping, as one of the rewards, inflation. You'd think this would be obvious but it isn't.

This article takes no position on whether inflation is defensible, whether it is a necessary price to pay for a dynamic economy today that tries to provide missiles, bread, and color TV sets for all. (We should instead ask if inflation is an *acceptable* price to pay.) It takes the position that inflation is our responsibility, not that of the other fellow or of the pressure groups, the bureaucrats, the military, the "free spenders." We're all "pressure groups."

"There is little point in blaming Washington. We are responsible," says Herbert Prochnow, a vice president of the First National Bank of Chicago. (Mr. Prochnow speaks specifically of "big" government, but his implication is clear.)

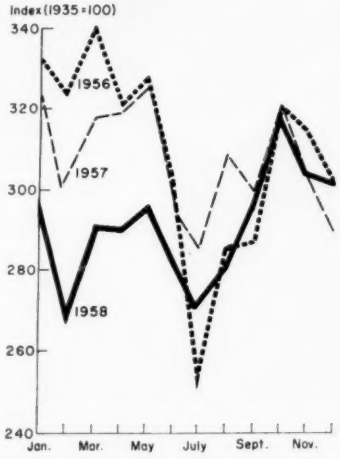
"The government has now become a vital factor in most of the nation's major economic decisions, whether they involve business, agriculture or labor. Furthermore, there seems to be widespread willingness to have government assume this role."

So lucidly does Prochnow place responsibility where it belongs that, although I don't share his banker's innate hostility to inflation, I feel you should read more of what he has said.

Read it and think. Are you willing to give up inflation or willing to accept it? It's your choice. There's a price to be paid either way.

- We expect government to provide security for tens of millions of us in our old age.
- We expect government to provide a vast expansion of our highway system.
- We expect larger contributions from government to improve our particular harbor or river.
- We expect government to determine the number of hours we work, our minimum wages and our unemployment compensation.
- If a strike threatens to tie up a great industry for weeks, we expect the government to prevent it.
- If housing construction declines, we expect the government to arrange easier credit, lower down payments and other remedies.
- If we seek slum clearance, we ask the government to provide a large part of the funds required.
- If metal prices fall, we demand larger government stockpiles, regardless of whether present stockpiles are considered adequate for national defense.
- If the price of an agricultural product falls, we demand price supports even though large stockpiles result.
- If we feel the competition of foreign products, we ask the government for tariffs or import quotas to help us compete.
- If we are engaged in small business, we want government to establish agencies to help us with our particular problems.
- We contribute our time and money to an infinite number of organizations which seek to get something from government or urge the government to expand its activities.
- On one day we write our Congressman to reduce government expenses and taxes. The next day we write him to bring home the federal bacon to our communities and our businesses.
- We ask for a reduction in government expenditures, but not for the federal projects in our own communities, or where it would affect our businesses.
- With one hand we work to reduce the role of government in our economic life. With the other hand we work even harder to increase it.
- We condemn the expanding role of government over the world, but we encourage it here.

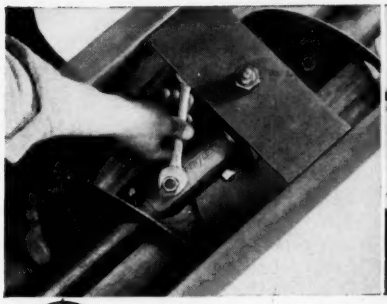
Chemical Consumption



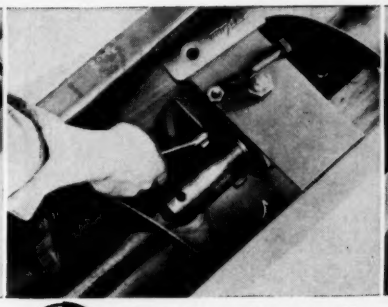
Consumption by Industries

	Dec. (Final)	Jan. (Est.)
Coal products	9.7	9.5
Explosives	10.1	8.8
Fertilizer	71.0	73.4
Glass	23.8	25.6
Iron & steel	16.0	17.1
Leather	4.3	4.4
Paint & varnish	26.0	29.4
Petroleum refining	32.1	33.0
Plastics	28.6	28.6
Pulp & paper	35.8	39.4
Rayon	27.7	26.4
Rubber	7.3	7.8
Textiles	9.8	10.2
Total	**302**	**314**

First time you've ever seen a conveyor screw changed so fast!

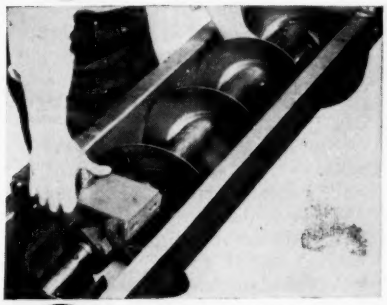


First, take out coupling bolts and filler piece from right-hand end of section to be removed.



Second step: take out coupling bolts and filler piece from the preceding section.

Rotate screw being removed 180 degrees so slot on preceding section is up. Then unbolt hanger.



Now simply lift the conveyor section from the trough and assemble the new one in its place.

RUNNING AGAIN. After less than 30 minutes, the conveyor is back at work.

LINK-BELT Quik-Link conveyor screw eliminates need to pull down entire conveyor line

Down-time is held to the barest minimum with the Quik-Link conveyor screw. It speeds and simplifies the maintenance man's job . . . other components need not be dismantled. And Quik-Link is just one of a whole group of new Link-Belt screw conveyor components that are cutting maintenance and power demands to a new low.

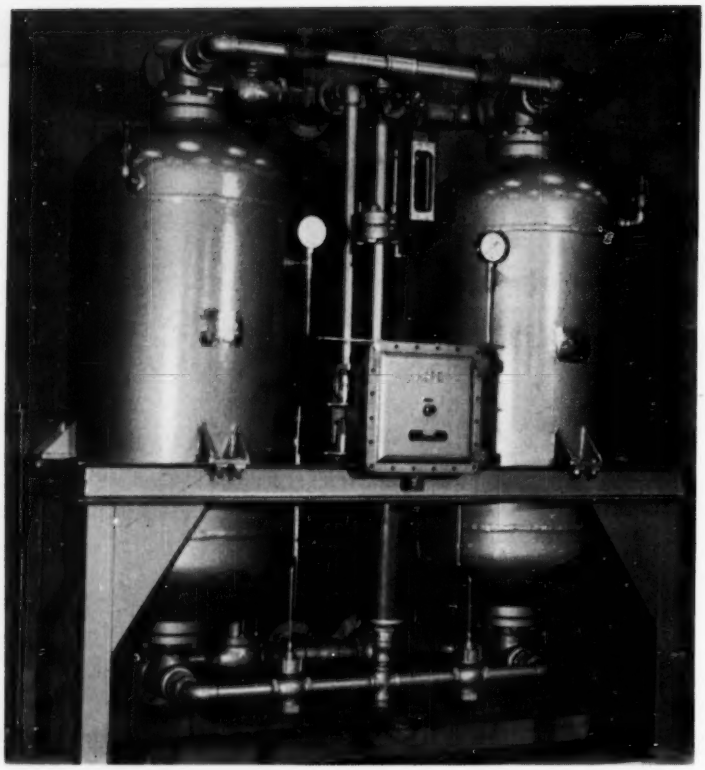
- *BALL BEARING HANGER*—has self-aligning bearing and seal, adjusts to deflection.
- *BALL AND ROLLER BEARING COUNTERSHAFT END*—connects two conveyors at right angles, permits use of a right-angle drive.
- *TROUGH END SEAL*—keeps grease in, dirt out. Used with lip, felt or waste packing seal to prevent bearing-product contact.
- *DOUBLE BALL BEARING FLANGE BLOCK*—resists overhung loads at drive end and takes thrust loads of screw.

For complete facts, call your nearest Link-Belt office or authorized stock-carrying distributor. Or write for Folder 2489.

LINK-BELT

SCREW CONVEYORS

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office, New York 7; Australia, Marrickville (Sydney); Brazil, Sao Paulo; Canada, Scarboro (Toronto 13); South Africa, Springs. Representatives Throughout the World. 14,089



Dryer for Compressed Air

Novel regeneration method gives dew points of −200 F. with no heat input—but at expense of compressor horsepower.

If *X* cu. ft. of compressed, moisture-laden air passes through a desiccant bed of sufficient size, most of the air's moisture will be adsorbed. Then, if *X* cu. ft. of completely dry air passes through this desiccant, the bed will give up the previously acquired moisture.

If the volume of dry air passing through the bed exceeds *X* cu. ft., the desiccant will become "super" dry, and will be more effective in drying *X* cu. ft. of unprocessed wet air.

Effective application of these principles enables Trinity Equipment Corp.'s Heat-Les dryer to deliver large volumes of air having a dew point below −200 F., as determined by a refrigerated measuring system.

▶ **Application of Principles** — Heat-Les dryers consist of two desiccant-filled chambers plus appropriate switching valves and piping. In operation, a constant flow of wet, compressed air passes through one of the chambers and is dried. About 15-25% of the dry air then expands through an orifice to a lower pressure, and flows through the second chamber, then to a vent; the remaining dry air discharges to instrument or process lines.

At the lower pressure, the volumetric flow of the 10-25% stream exceeds that of the wet air entering the first chamber; thus, the desiccant in the second chamber becomes "super" dry.

Finally, the switching valves reverse the entire procedure, and wet air enters the second chamber, while the desiccant in the first chamber undergoes reactivation.

▶ **Advantages and Sizes**—Heat-Les dryers eliminate costly electric or steam requirements. They also offer the definite advantage of no increase in temperature of the effluent gas. In addition, the dryers remove oil vapors to a compressed-gas purity of 1 ppm.—prefilters or periodic desiccant changes are not required.

A large range of dryer sizes is available — from compact, wall-mounted units to floor models capable of handling 4,000 scfm. Working pressures can vary from 60 to 6,000 psi. — **Trinity Equipment Corp., Cortland, N. Y.** 64A

Pipe Insulation

For low temperatures. Has good thermal efficiency.

Pre-molded rigid polyurethane pipe-insulating material is claimed to have greater thermal efficiency than any low-temperature insulation now on

Lubrication News

PROFITABLE IDEAS ON THE LUBRICATION OF CHEMICAL PROCESS EQUIPMENT

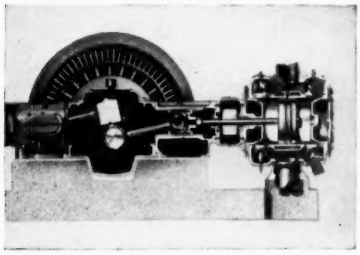
Carbon deposits in compressors are often a result of overlubrication

The plant engineer of a large basic chemicals plant recently handed us this problem: carbon deposits appeared regularly on the valves and cylinders of his air and gas compressors.

A Texaco Lubrication Engineer reviewed the possible causes. First, he checked the lubricants being used; the right lubricant had been specified for each compressor. Next, he examined the mechanical feed system that scheduled the rate of lubrication. Here, he found the feeders were set to admit too much lubricant into the compressors. This was obviously causing the carbon deposits.

He immediately recommended that trials be set up to determine the exact amount of lubricant required in each compressor. Intake valves, discharge valves and cylinder parts were frequently examined for presence of a thin oil film. Where dryness or light rusting appeared, lubricant feed was increased; excessive oil on the parts or in clearance spaces indicated the need for a reduced feed.

A Texaco Lubrication Engineer is always available for consultation on the choice and use of compressor lubricants.



Red arrows pointing to intake valves, discharge valves and cylinder ports show where to look for thin film of lubricant that indicates proper rate of feed. Deposits on valves are usually result of too much oil, poor grade of oil, or dirty intake air.

Notice to plants with water-seal gasholders

Corrosive effects of water and weather on water-seal gasholders can now be reduced through development of a new use for a Texaco Marine Product. Furthermore, the simple method of applying the product (we call it Floatcoat) sharply reduces maintenance costs by eliminating the need for rigs, scaffolds, and complicated application equipment.

To apply, Floatcoat is merely poured on the water seal. As the tank rises and falls, the coat is spread on the side of the tank automatically. It provides a tough, adhesive shield against both the water in the seal and the weathering effect of the elements. In addition, it penetrates and cleans out existing rust. It is resistant to water washing, needs to be renewed only after long intervals.

Mail coupon at right for more information.

STORAGE METHODS CAN DETERMINE LUBRICANT EFFICIENCY ON THE JOB

Lubricant performance depends to a large extent on the way the product is stored and handled by the purchaser before it's used. Here are some proven methods that will insure complete protection for stored lubricants.

To avoid contamination with water
Best lubricant storage is in a fireproof building. If lubricants are stored outdoors, however, drums should be placed on their sides, to prevent rainwater from being sucked through the seal by temperature changes. This is particularly important with oils containing additives, since some additives are damaged by water contamination.

Outside storage in cold climate
Low temperature makes lubricants stiff and hard to handle. Heating will restore a workable viscosity, but if too much localized heat is applied to a lubricant it may be rendered useless.

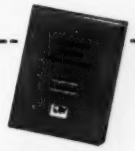
The best way to handle very cold lubricants is to put them indoors and let them reach room temperature slowly. The safest fast heating method is to use exhaust steam. An exposed flame may melt the sealing compounds on the drum and cause leaks.

Safe ways to transfer lubricants
A standard pump that fits the drum opening will prevent contamination in transferring lubricants from one container to another. In some plants the product is applied directly from the original container to the lubricating point. It's essential in any case to avoid using the same pump and hose for different types of lubricants, to prevent contamination.

Ideally the oldest stocks should be used first. All Texaco products are factory-dated to facilitate this procedure. Basic safety demands that the floor of the lubricant dispensing area be kept clean to avoid falls and fires—and fire-fighting equipment should be nearby, just in case.

Guide to Organized Lubrication

This book discusses organized lubrication from management's point of view—as a means of controlling costs. It discusses methods that help raise production, extend parts life, cut downtime. For free copy, use coupon below.



TEXACO INC.
Dept. CE-CP-20
135 East 42nd Street
New York 17, N. Y.

I am attaching my company letterhead to this coupon.

☐ Send a copy of Management Practices that Control Costs via Organized Lubrication.

☐ Send information on Floatcoat.

☐ Ask a Texaco Lubrication Engineer to call at my plant.

Name_____

Title_____

the market. Specifically designed for temperatures down to −300 F., the new material has been thoroughly field-tested and is now available nationally.

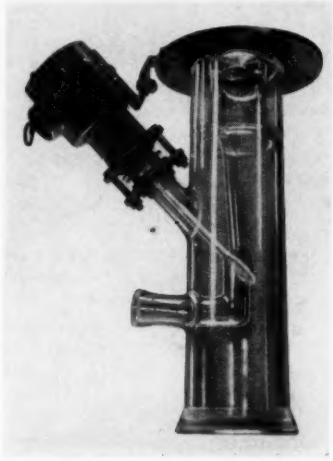
Formed of a mass of closed cells containing entrapped inert gas, B-H Rigid Foam has low permeability, is noncapillary, and is dimensionally stable. Material cost is competitive with other pipe insulations of comparable efficiency, but because of the low K-factor (0.096), substantially reduced thicknesses give the same thermal protection. Insulation comes in all standard IPS sizes from ½- to 12-in. diameter. Thicknesses range from ¾ to 2½ in. Sections are 3 ft. long. — **Baldwin-Hill Co., Trenton, N. J.** **64B**

Valve Operators

Two new units feature ease of installation.

A new, compact, economical and dependable Limitorque operator for use on small globe and gate valves (normally hand-operated) has standard output speeds of 22.5 or 45 rpm. To install the new operator, simply remove the handwheel of an existing valve, and mount Limitorque on the same bonnet.

For motorizing wrench-operated plug valves, the manufacturer is also offering the Limitorque linear operator (not shown). This unit consists of a motor and double-reduction gearing that drives a traveling screw and crank. Mount the crank on the plug shank, strap the support bracket to the pipe and the linear operator is ready for service.—**Philadelphia Gear Corp., Philadelphia, Pa.** **66A**



Reflux Splitter

Has only one moving part. Permits view of stream.

Having only one moving part, a new, simplified, automatic reflux splitter constructed of Pyrex-brand glass and Teflon resin provides full visibility of flow, and complete corrosion resistance to all liquids other than hydrofluoric acid and hot concentrated caustics.

In operation, an adjustable timer energizes a solenoid, which pulls up the Teflon gate to open the reflux line. Pressure ranges, available in both column and in-line designs, vary from 15 to 50 psi., with maximum temperatures to about 450 F.—**Chem Flow Corp., Lodi, N. J.** **66B**

For More Information . . .

about any item in this department, circle its code number on the

Reader Service

postcard (p. 177)

Stainless Steel Building

Encloses large areas. Withstands harsh atmospheres.

An all-stainless steel building—first of its type—for use in corrosive atmospheres offers efficient means of enclosing large areas without pillars, posts, braces or trusses of any kind. The structures are available in widths from 20 to 180 ft. and in any lengths.

Each permanent building consists of interlocking panels bolted together to form self-supporting arches that become the walls and roof all in one. Fabricated from deep-formed stainless steel sheets, the 2-ft. wide panels are double-curved and corrugated to provide uniform rigidity and strength. Building erection takes only a few days.—**The Wonder Building Corp. of America, Chicago, Ill.** **66C**

Packaged Feeders

For granular materials. Install quickly.

Compact feeders that can be installed in only two steps facilitate the introduction of material into any kind of air-pressure conveying unit. The packaged feeders will handle any material that can be conveyed pneumatically, and will feed from bin, hopper or conveyor.

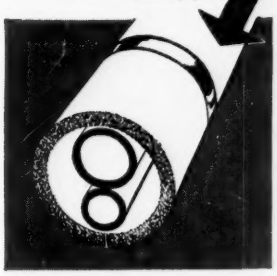
After uncrating, the rotary-vane assembly is simply put into position, and a single air connection made. It is then ready to operate. Flexibility of

Now! One-pipe steam-traced systems with new Reynolds Aluminum Duplex Pipe with steam line built-in.

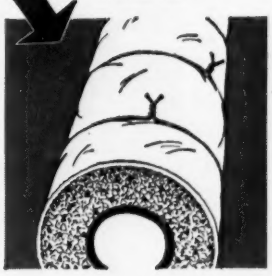
THIS ELIMINATES

THESE UNNECESSARY COSTS:

...the cost of steam jacketing and extra pipe



...the cost of excessive insulation



Now a complete steam-traced system can be installed in one pipe: Reynolds new Aluminum Duplex Pipe.

This tough, lightweight pipe has a *built-in* steam line . . . it eliminates the need for steam jacketing . . . it eliminates outside steam-trace lines . . . it permits use of standard insulation . . . it's a complete steam-trace system in one pipe.

Installation is fast and simple, too, with Reynolds Duplex Pipe. It's lightweight and easy to handle, join and weld, and can be formed readily with ordinary hydraulic pipe bending equipment.

The new Reynolds Duplex Pipe can improve heating efficiency, and reduce the need for insulation. Aluminum has high thermal conductivity, low emissivity. This means better heat transfer within the Duplex Pipe, less heat lost, less insulation needed.

And, like the Reynolds Aluminum Process Pipe that is handling the roughest jobs in the chemical processing and petroleum industry, the new Duplex Pipe stands up against corrosion.

Reynolds Duplex Pipe is available in four sizes —1½", 2", 3" and 4"—and in alloys 3003-F, and 6063-T5.

The Finest Products Made with Aluminum are made with REYNOLDS ALUMINUM

Get full information on Reynolds Duplex Pipe

FREE BROCHURE

Write today for a free brochure on Reynolds Aluminum Duplex Pipe, for details on joining, sizes, alloys and pressure ratings. *Reynolds Metals Company, P.O. Box 2346-CJ, Richmond 18, Virginia.*

Watch Reynolds TV show—"WALT DISNEY PRESENTS"—every week on ABC-TV

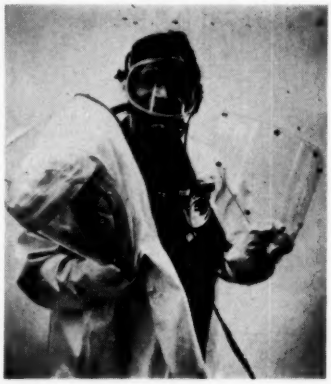
installation is provided by the fact that the feeder can either be hung from a hopper or supported on its own base. Available in ½-, ¾- and 1-hp. units.—**Fuller Co., Catasauqua, Pa. 66D**

Reference System

Helps put spectrograms to best possible use.

Tennessee Eastman Co. Research Laboratories and the Recordak Corp. have recently joined talents to develop a new system for the recording, filing and dissemination of industrial reference spectral data. With this system, spectrograms from laboratory and process instrumentation are microfilmed and mounted on standard aperture cards. Additional information on the coded cards can include empirical formulas and chemical names.

One important feature of this system is that two cards can be placed into a reader at the same time, one on top of the other, to compare, simultaneously, two different chemicals, runs of the same chemical, etc.—**Recordak Corp., New York, N. Y. 68A**



Emergency Suit

Rescuer can quickly don. Protects user from vapor.

Developed especially for use where acid and vapor protection is required, the Model 75/20 emergency suit can be used with any type of self-contained breathing apparatus.

Each suit is constructed with full-cemented seams, gum-strapped on the outside, and is completely vulcanized after assembly—there are no needle holes. One man can put on the breathing apparatus and get into the suit in just 3 min. Model 75/20 will accommodate a man up to 6 ft. 4 in. tall, and 250 lb. in weight.—**Union Industrial Equipment Corp., Port Chester, N. Y. 68C**

Metering Pumps

Many sizes; various materials of construction.

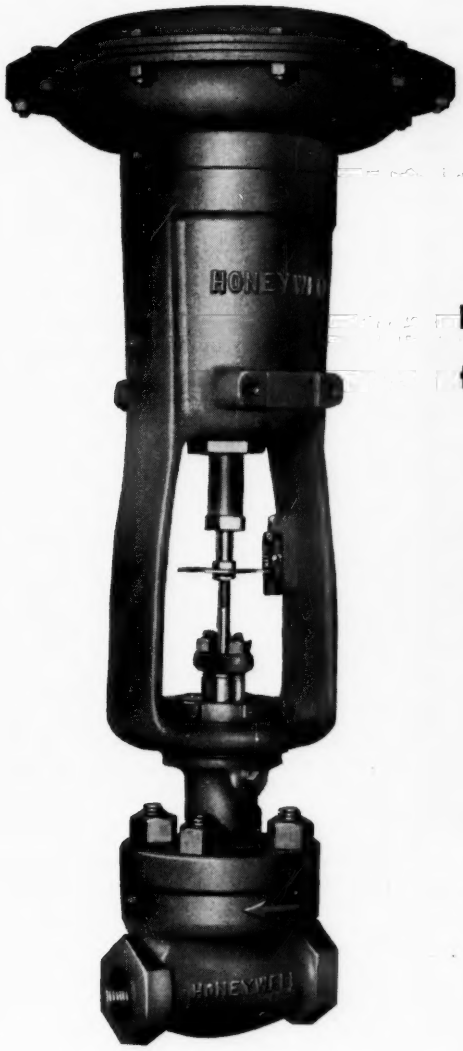
A new line of controlled-capacity pumps for metering services includes both plunger- and diaphragm-type models. Unitized design of basic components permits conversion

It's Curtains for Better Drying in Dryer-Cooler

One of the noteworthy features in Standard Steel's rotary dryer-cooler combinations is the sawtooth lifter. Lifter design and arrangement assure effective exposure of feed materials to the hot air stream. Products are showered in "curtains" rather than in distinct thin lines, enormously increasing heat-transfer surface area. Space-saving Standard dryer-coolers are generally priced about 20% lower than equivalent equipment coming as two separate units. Maintenance costs are also less.—Standard Steel Corp., Los Angeles, Calif. 68B

EQUIPMENT NEWS Continues on . . . Page 152

is your PROCESS FLOW SMALL?



Honeywell control valves are available for a wide range of flows

Whether your process flow is a trickle or a torrent, there's a Honeywell automatic control valve to meet your requirements. The Honeywell valve illustrated—Series 800, Type 14 Low Flow—is designed to control small process flows. For each body size, there are interchangeable reduced plug and seat ring combinations . . . with flow coefficients ranging from Cv 0.33 to 8.2. Ultra-low flow plugs are available with Cv's as small as 0.01.

For small or large flows . . . or other process flow conditions . . . Honeywell valves are available in a variety of types and sizes. When you need control valves . . . contact your local Honeywell field engineer. Write for new Catalog C800-1.

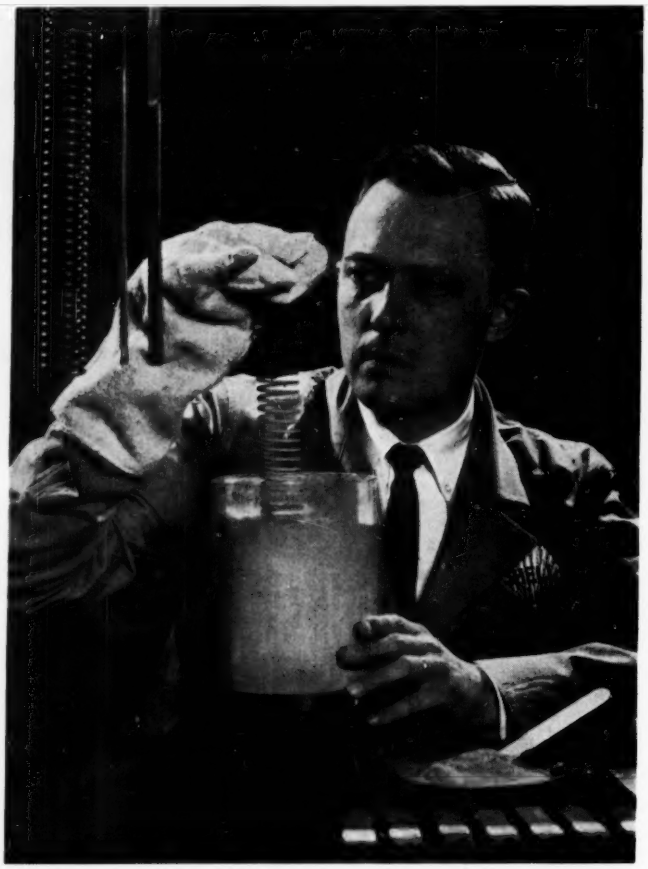
MINNEAPOLIS-HONEYWELL, Fort Washington, Pa.

Honeywell

First in Control

DEVELOPMENTS . . .

CHEMICAL PRODUCTS EDITED BY FRANCES ARNE



He's Painting the Spring With Powdered-Paint-in-Air

Instead of volatile solvents that are normally used to make paint a liquid, a new process uses heat and a flow of air. A metal object, like the spring shown above, is heated, then dipped into a container where a powdered paint is kept suspended in a cloud-like consistency by air flowing upward through the container. The heat of the object melts the dry particles of paint that touch it.

To coat hard-to-paint metal objects—the primary use of the new process — Shell Chemical has developed a powdered paint based on its Epon resin which gives a smooth coat to knife-edges, will not flake loose from springs on compression.

The paint will be made in the U. S. by several formulators. The process was invented in Germany and licensed in the U. S. by Polymer Process Industries, Reading, Pa.—Shell Chemical Corp., New York, N. Y. 70A

Acetate Gums

Acetylation increases cornstarch's utility in textiles, paper.

A new family of non-congealing starch products, called Miralloid and Mira-Film acetate gums, are made by the acetylation of corn starches. Although the degree of acetylation of each product is not great, properties of the resulting products differ greatly from the original starches.

Miralloid acetate gum has proved particularly suited for warp sizing in the textile industry, where it has increased weaving efficiency 1.5% on fine combed cotton yarns and 1 to 3% on worsted and worsted-synthetic fiber blends in extended test comparisons with such previous sizings as potato starch and starch-acrylic emulsion combinations. Other qualities noted for Miralloid gum are quick cooking, stable viscosity on cooling.

A new series of wide-ranging Mira-Film acetate gums is finding important uses in the paper industry, where extensive laboratory and mill tests have shown effective performance in many varied surface sizing and coating applications.

Process, developed by A. E. Staley Mfg., is based on an entirely new starch reaction. It is said to be unusual in its simplicity and ease of control, and to afford exceptionally uniform product results.—**A. E. Staley Mfg. Co., Decatur, Ill. 70B**

Semiconductor Material

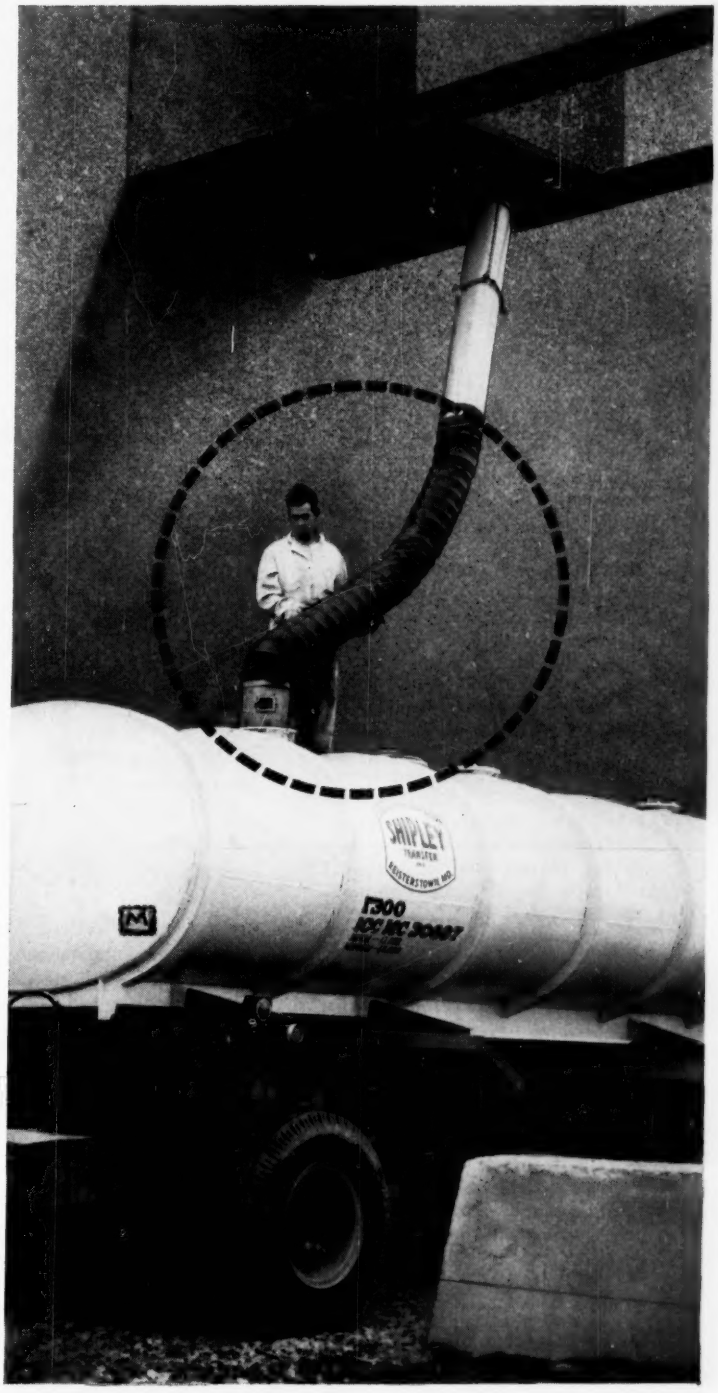
Designed for thermoelectric use: indium arsenide phosphide.

A new thermoelectric material—indium arsenide phosphide—has been developed for use in the temperature range from 850

Closed system protects quality of SOLVAY *Anhydrous* ALUMINUM CHLORIDE

Contamination by air can destroy the purity and reactivity we take such care to produce in Solvay® Anhydrous Aluminum Chloride. So, from production to packaging we protect it from atmospheric moisture. An example of this is the airtight chute (circled) used in loading the Solvay-designed truck for bulk shipments. Similar precautions are taken in filling the various sizes of steel drum packages to assure product quality and safe handling.

This care continues right into the customer's plant . . . through Solvay Technical Service that helps plan handling procedures and bulk storage systems. For further information, including the range of screen sizes, mail the coupon.



Sodium Nitrite • Calcium Chloride • Chlorine • Caustic Soda
Caustic Potash • Potassium Carbonate • Sodium Bicarbonate
Chloroform • Methyl Chloride • Soda Ash • Vinyl Chloride
Ammonium Chloride • Methylene Chloride • Snowflake® Crystals • Monochlorobenzene • Ortho-dichlorobenzene
Para-dichlorobenzene • Ammonium Bicarbonate • Carbon Tetrachloride • Hydrogen Peroxide • Aluminum Chloride
Cleaning Compounds • Mutual® Chromium Chemicals

Allied Chemical

SOLVAY PROCESS DIVISION
61 Broadway, New York 6, N. Y.

SOLVAY branch offices and dealers are located in major centers from coast to coast.

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ALLIED CHEMICAL CORPORATION
61 Broadway, New York 6, N. Y.

Please send material on anhydrous aluminum chloride as follows:

☐ Bulk shipment data ☐ Test sample
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to 1,500 F. This top temperature is well above the melting point of aluminum, magnesium and many common thermoelectric materials.

The new semiconductor material is prepared by chemically combining high-purity indium with equally pure arsenic and phosphorus. It is expected to find immediate use in thermoelectric devices operating at temperatures well above those previously considered practical. —**Westinghouse Electric Corp., Pittsburgh, Pa.** **70C**

Urethanes

Phosphorus-containing polyol adds fire retardance to base molecule.

A newly-developed phosphorus-containing polyol makes urethane foam fire retardant when substituted for some of the polyol conventionally used to form the urethane molecule.

Usual approach to fireproofing urethane foam has been via additives. Their cost simply adds to that of standard amounts of urethane constituents.

Called Vircol-82 and available in developmental quantities, the new product can be used for polyether- or polyester-based flexible foams and polyester-based rigids. At the development price of 70¢/lb. in truckload drum quantities, they would permit manufacture of polyester-based foams of competitive costs. Small sacrifice in cost would be needed for polyether-based foams. However, development price is expected to drop 7 to 8% upon volume production.

Rigid foams would contain 10-12% Vircol material (which contains about 12% phosphorus). When more than 5% of Vircol-82 is used in rigid foams, low molecular weight, highly functional polyols such as glycerine, hexanetriol, etc., also may be incorporated in amounts calculated to compensate for the lower functionality and 212 hydroxyl number of Vircol.—**Virginia-Carolina Chemical Corp., Richmond, Va.** **72A**

Urethane Foam

Two new processes improve polyether-based flexible foams.

A new one-shot method of producing polyether flexible foams is said to reduce manufacturing time. Simultaneously, the method is said to boost product quality.

The method eliminates a number of intermediate production steps and makes possible the addition of all components right at the mixing head which produces the foam.

Greater uniformity in cell structure is claimed, which creates 10 to 15% greater resilience. A higher load bearing foam can be made and there is an improvement in humidity aging.—**General Tire & Rubber Co., Akron, Ohio.** **72B**

With another new process for making polyethers, flexible foams of a consistent quality not previously available are said to be obtained.

Completely odorless from the moment of manufacture, these foams can be made in an exactly controlled range of compressibility from very soft to very firm. The foam is already in production and can be supplied immediately in medium or seating grade softness in 48-in. widths or multiples thereof.—**Nopco Chemical Co., North Arlington, N. J.** **72C**

Curing Agent

Resin speeds butyl cure without catalyst.

A new bromo-methyl alkylated phenol-formaldehyde resin is said to reduce the cure time of butyl rubber and to provide improved heat resistance and compression set properties.

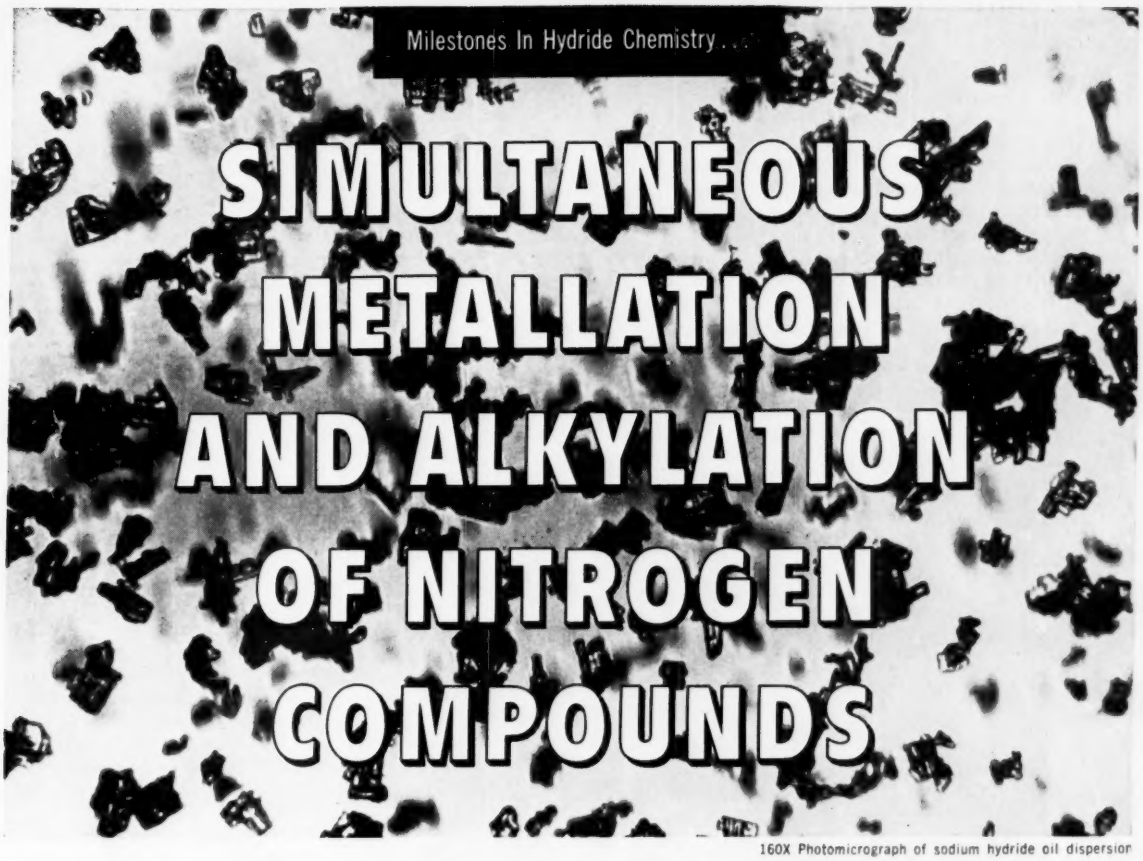
Designated SP-1055 Resin, it makes possible curing of butyl rubber in 10- to 60-min. cycles at temperatures of 300 to 350 F. Unlike present resin-curing systems, no catalyst is required to effect the cure.

Not only are highly uniform cures achieved with the new resin, but the rate of cure is easily controlled by choosing the proper grade of butyl rubber. For example, very rapid cures can be obtained with a grade of butyl rubber possessing a high degree of unsaturation.

SP-1055 resin also makes pos-

Newsworthy Chemicals

For more details, use Reader Service Card



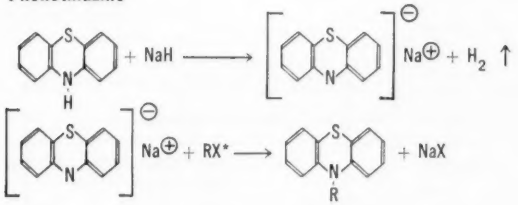
160X Photomicrograph of sodium hydride oil dispersion

With MHI Sodium Hydride Oil Dispersion

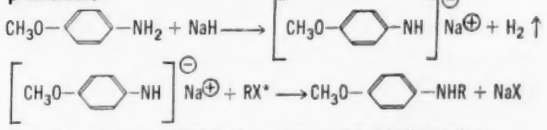
In a single step, in many cases, MHI NaH in oil will simultaneously metallate and alkylate a wide variety of nitrogen compounds in high yield. Using simple processing techniques, and eliminating NH_3 as a reaction medium, NaH reacts fast at moderate temperatures. Inert to reactive organic halogen compounds it avoids the Wurtz-Fittig reaction. Reactions are easily followed by the hydrogen evolved (the only reaction by-product).

Using diglyme (dimethyl ether of diethylene glycol), dimethyl formamide, or mixtures of these with hydrocarbons as solvents, here are selected examples:

Phenothiazine

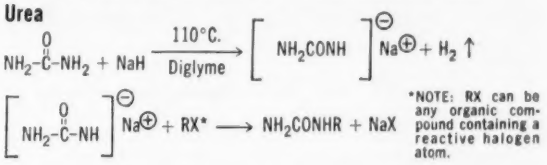


p-Anisidine



This process can be repeated to give an unsymmetrical tertiary amine.

Urea



*NOTE: RX can be any organic compound containing a reactive halogen atom.

MHI NaH oil dispersion is available in quantity as a stable 50% mealy dispersion of 5-20 micron crystals in mineral oil. The oil coating protects reactivity, even in air, making it easy and safe to handle.

Write for your copy of the 20-page brochure, "Sodium Hydride Dispersed In Oil," a manual covering properties, reactions, handling and safety.

CHEMICAL HYDRIDE DIVISION

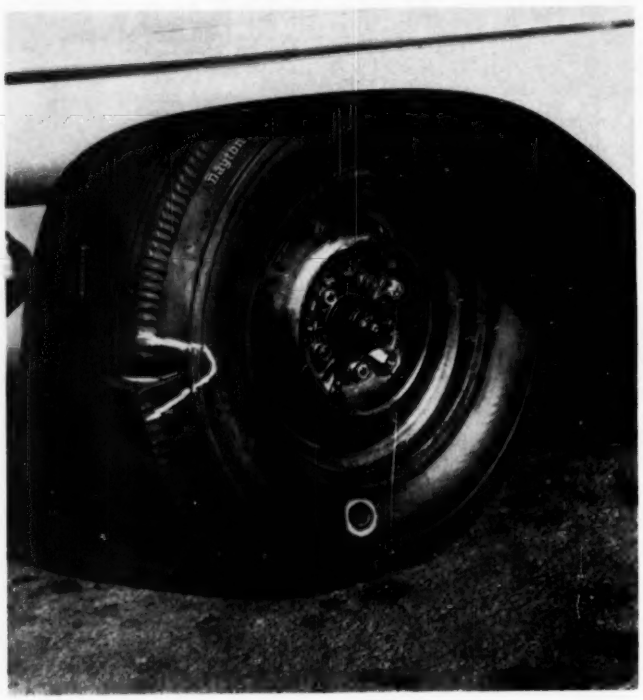
Metal Hydrides Incorporated

PIONEERS IN HYDRIDE CHEMISTRY

61 W. CONGRESS STREET, BEVERLY, MASSACHUSETTS

sible production of butyl rubber parts capable of withstanding exposure to temperatures up to 500 F. for long periods, without losing their resiliency. Flex life, permanent set and dynamic fatigue characteristics of butyl rubber containing the resin are said to be considerably improved in comparison to sulfur-cured butyl.

The new resin has been engineered to give a safe scorch range for wide process application. It may be added to a compound either on the mill or in the Banbury. — **Schenectady Varnish Co., Schenectady, N. Y. 72D**



Foam-Filled Tire Rides Easy Even After Mutilation

A 3-in. wide and deep, pie-shaped wedge was cut across an experimental tire and into its foamed urethane filling. Tire remained intact without dissipation or protrusion during subsequent driving.

The filling, a controlled density urethane foam or special formulation, forms a permanent bond with both the casing and metal rim, its adhesion being as great as its cohesion.

Initial road tests indicated greater stability and less lateral distortion during high speed cornering and better shock absorption with the reciprocal bouncing effect shown by air-filled tires.

Called Polyrubber, the filling has been used extensively in specialized aircraft and missile components and assemblies which require a material that maintains high hysteresis and resiliency under extreme conditions of corrosion, vibration, high pressure and exposure to the elements.—American Latex Products Corp., Los Angeles. 74A

BRIEFS

Adhesive for heat bonding dissimilar unvulcanized elastomers is now available for evaluation. Designated EX-B150-1, it fills a particular need when one of the stocks involved is based on butyl rubber.—**Lord Mfg. Co., Erie, Pa. 74B**

Valeric, iso-pentanoic and 2-methyl-pentanoic acids are now available on a commercial scale. Clear, water-white liquids, they undergo the usual reactions of organic acids to form salts, esters, amines, amides and halides. Introductory prices are relatively low at 30¢/lb. in tank cars.—**Union Carbide Chemicals Co., New York. 74C**

Vat dyestuffs in grain form have been introduced to meet the needs of operators of continuous dyeing processes involving padding. Known as SQ Caledon Grains, they have a high rate of reduction, fine controlled particle size when dispersed, a uniformity of deposition in padding and low tendency to migrate.—**Canadian Industries Ltd., Box 10, Montreal, Canada. 74D**

Light-stable epoxy varnishes recently developed are said to combine the best features of epoxy and alkyd varnishes. Based on the company's Epoxide 201, they are free from the light-sensitive phenolic ring structures of conventional epoxy resins, contain the epoxide groups that allow formation of chemical-resistant polyether polymers. — **Union Carbide Chemicals Co., New York, N. Y. 74E**

For More Information . . .

about any item in this department, circle its code number on the

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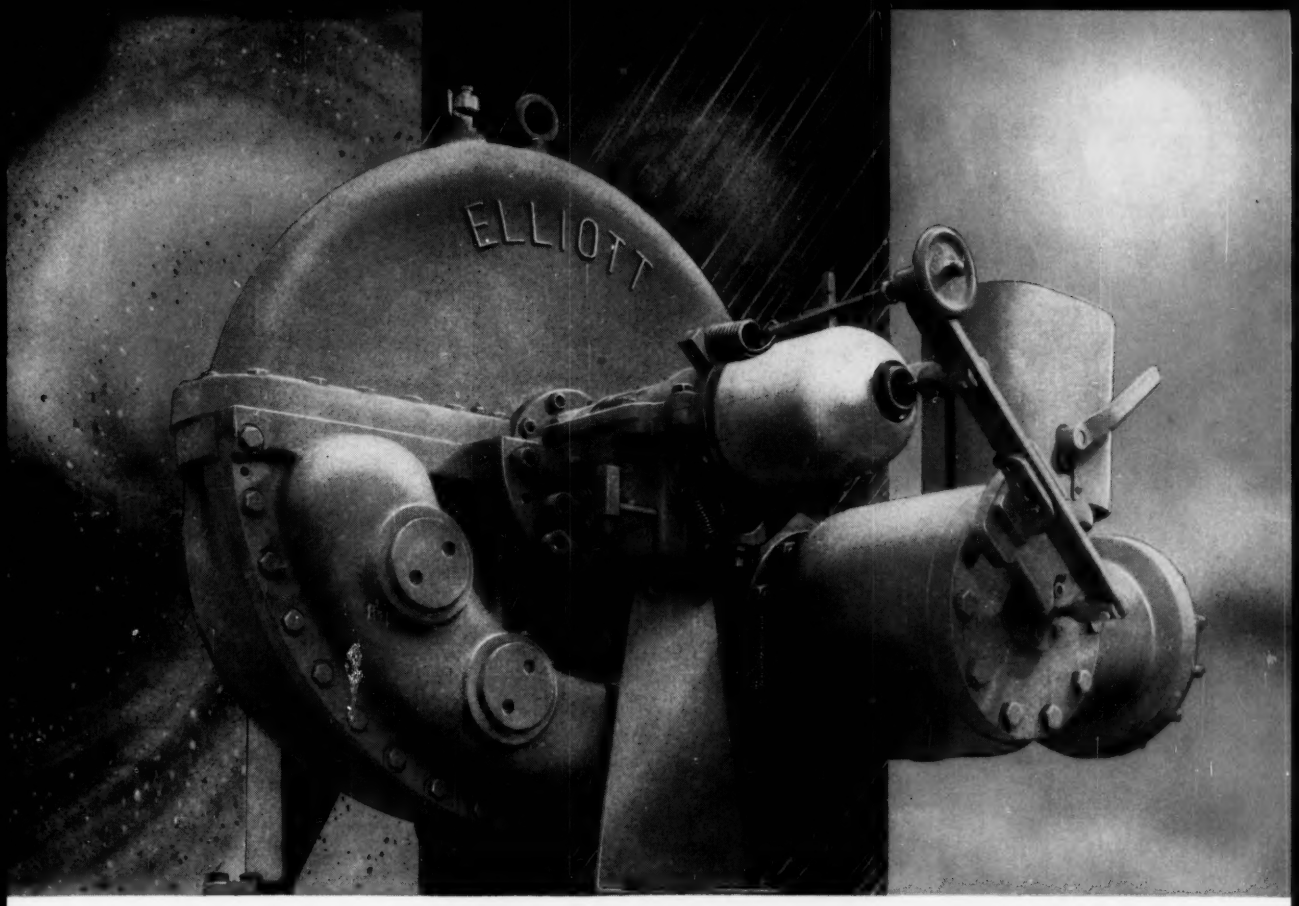
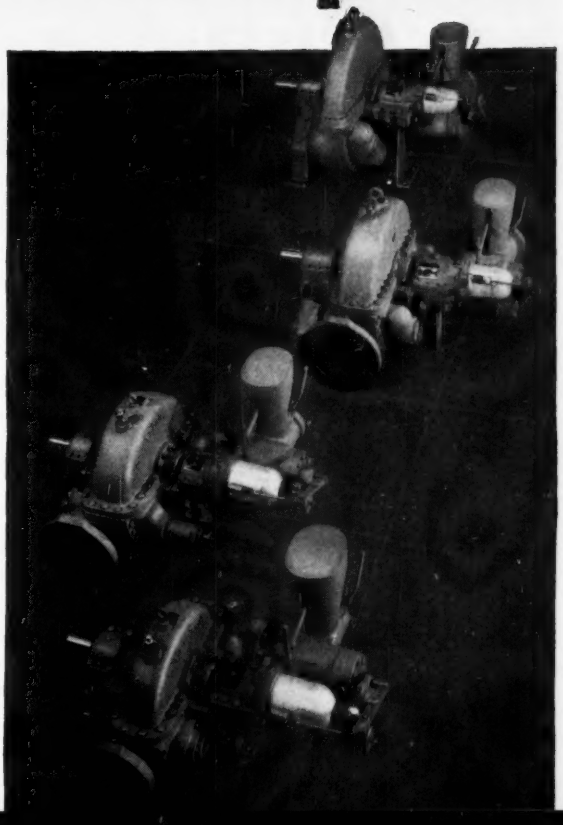


rugged and weatherproof

ELLIOTT YR TURBINES

Desert heat, arctic cold, driving rain and swirling dust don't faze rugged, dependable Elliott YR Turbines. Tightly sealed against dust, fumes and moisture . . . built strong and husky . . . these machines make dependable, economical drives for pumps, compressors, fans, line shafts, generators and other equipment.

The governor is simple and reliable, and is available in several modifications to match speed and pressure control requirements. YR turbines are designed for easy installation and service. Many key parts are interchangeable for various frame sizes. Four sizes are shown at the right. Write for descriptive bulletin H22-C.

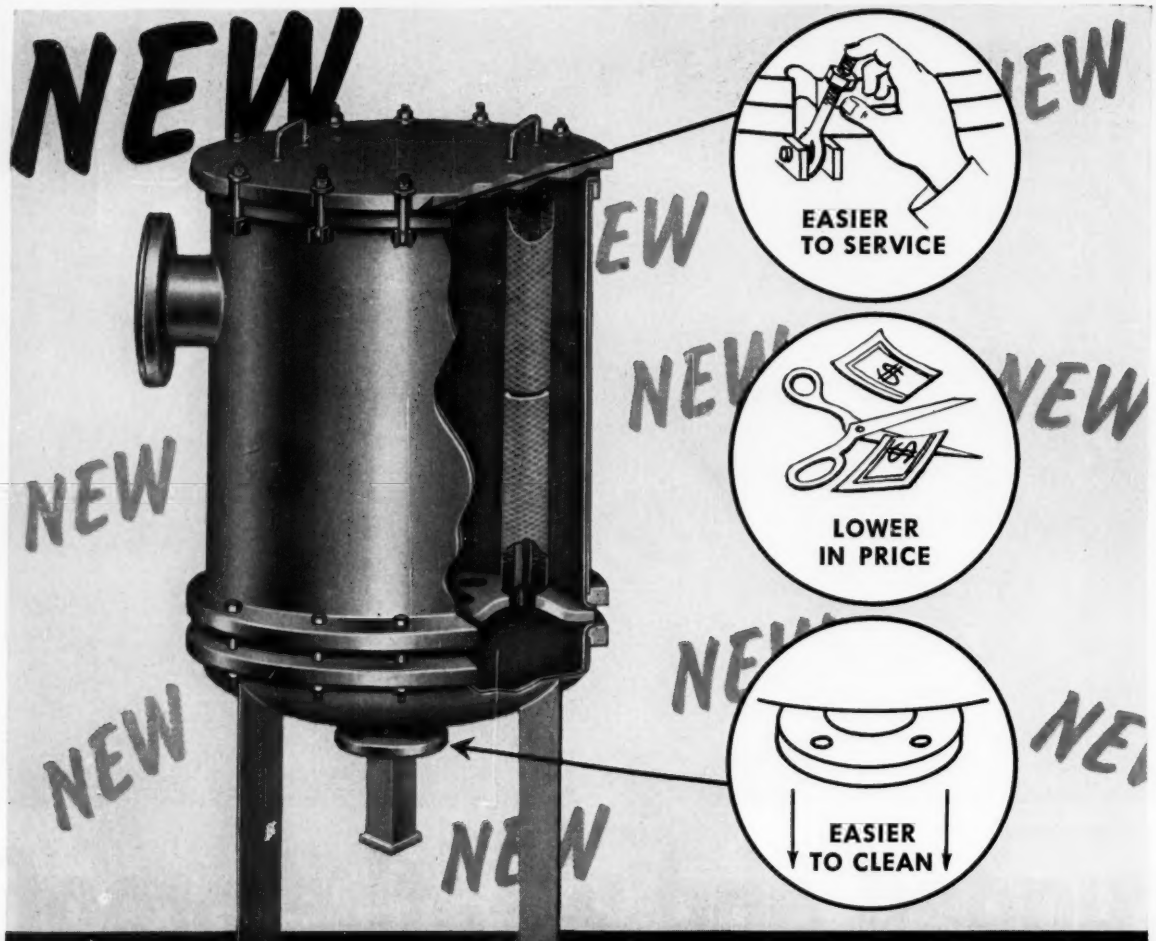


In addition to the units illustrated here, Elliott makes single-stage turbines in special frames, reduction gears, multistage mechanical drive turbines to 50,000 hp, and turbine-generators through 44 mw.

TURBINES FOR DEPENDABLE day-in/day-out SERVICE

ELLIOTT Company

JEANNETTE, PENNSYLVANIA H9-2



"SWING-BOLT" *Fulflo* FILTER CUTS YOUR PLATING COSTS

Now . . . the new Fulflo Rubber-Lined Steel Filter for plating cuts your filter maintenance costs in half, while providing tank turnover up to 3 times per hour.

New swing-bolt cover simplifies and speeds up changing elements. Just loosen the bolts, swing them out of the way, and lift off the cover to provide complete access to the patented Honeycomb Filter Tubes. Tubes are completely changed in a matter of minutes.

New bottom outlet allows for quick, easy cleaning of entire vessel simply by addition of a "T" connection with drain valve. You save time and labor.

Best of all, new engineering and production refinements enable us to offer this filter at an even lower price than the previous model.

The new Fulflo Rubber-Lined Steel Filter is offered in six sizes, with from 6 to 60 Honeycomb Filter Tubes, for capacities up to 18,000 gph. Steel or stainless steel containers are also available.

It will pay you to look into this new Fulflo Filter to improve plating quality at lower cost.

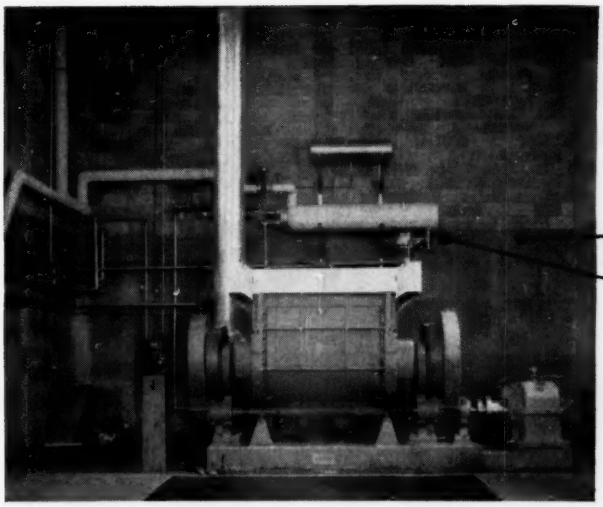
For qualified engineering advice, or new technical literature, write to Department CE.

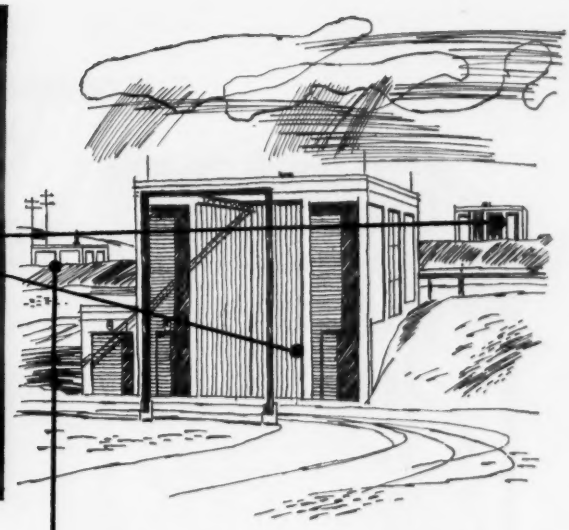
COMMERCIAL FILTERS CORPORATION
MELROSE 76, MASSACHUSETTS
PLANTS IN MELROSE, MASSACHUSETTS AND LEBANON, INDIANA

MICRO-CLARITY AT MINIMUM COST

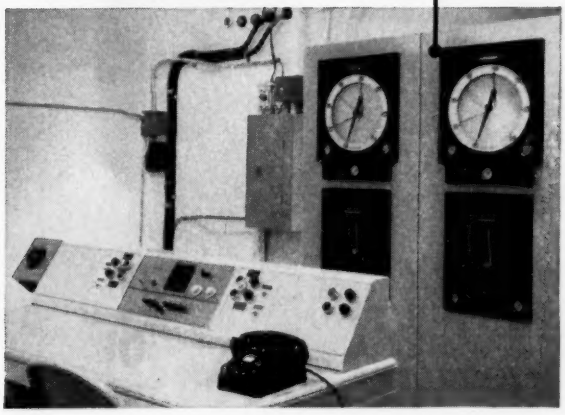
Fulflo FILTERS — *with genuine Honeycomb Filter Tubes for controlled micro-clarity of industrial fluids.*

CFC FILTERS — *Selective filtration of oils • water-oil separators • magnetic separators • pre-coat filters • coolant clarifiers • automatic tubular conveyors.*





TWO MORE BAKER PERKINS MIXERS ON THE JOB at new Thiokol® solid propellant plant in Utah

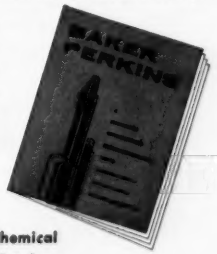


Inorganic oxidizers, the chemicals which make solid rocket propellants burn with such intensity, are first ground to a particle size . . . blended thoroughly . . . then mixed with an elastomeric binder. Fundamentally, that's how Thiokol Chemical Corporation makes a fuel for a rocket motor. The mixing of high energy fuels is a delicate, exacting operation and the mixers must be highly efficient and absolutely dependable.

At the Brigham City, Utah plant, Thiokol has recently installed two more Size 18 JWRM-2 Baker Perkins mixers. Each of these mixers is constructed of stainless steel and has a 300 gallon working capacity. The units, housed in specially constructed buildings, are remote controlled from another building.

Because they are safe *and* efficient, more and more B-P mixers are being used by the rapidly expanding propellant industry. These same high standards of quality are also incorporated into the standard design mixers built for the chemical process industry.

Whatever your requirements may be, Baker Perkins builds mixing machinery to handle every job. Why not write today for Bulletin No. CE-58 containing information on B-P equipment for the chemical process industries.



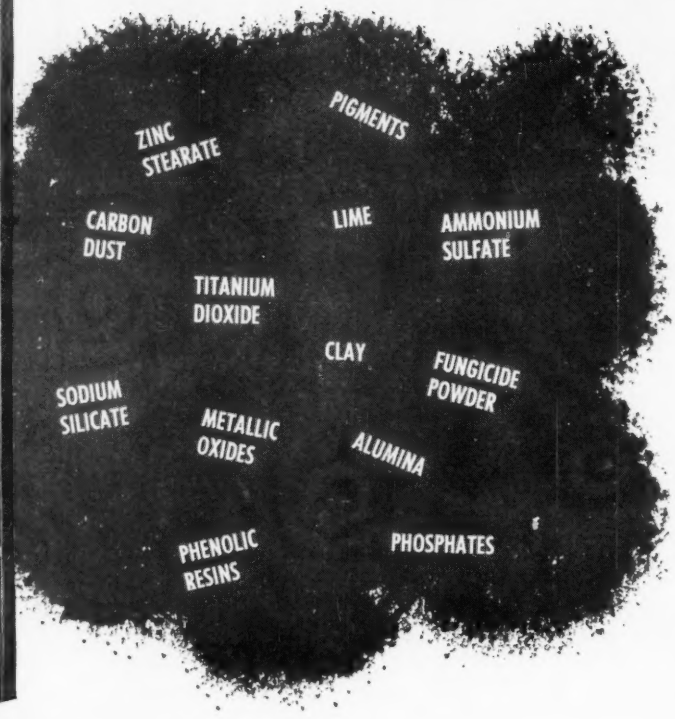
BAKER PERKINS INC.

See our insert in Chemical Engineering Catalog.

CHEMICAL MACHINERY DIVISION • SAGINAW, MICHIGAN

365

Do you have a DUST PROBLEM?



AAF AMERjet DOES MANY JOBS FOR CHEMICAL PROCESSORS

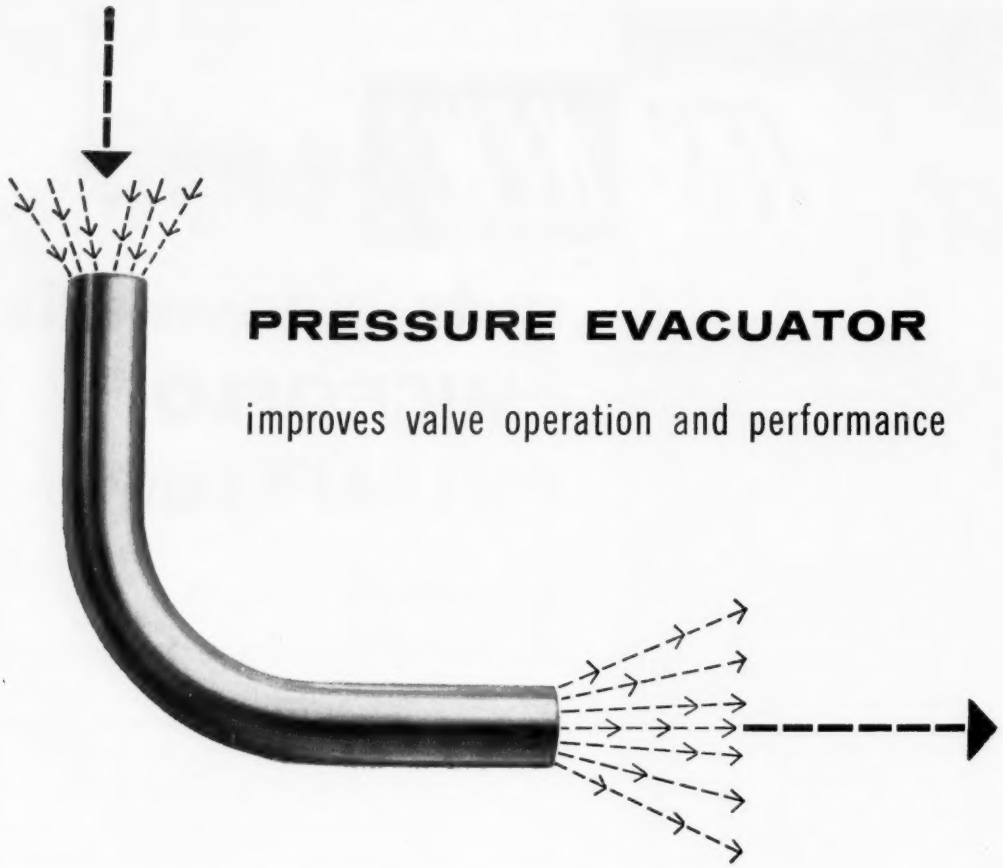
If your operations require *complete dry dust recovery,* and collection of the *very finest* particles, you've got a job for AMERjet. *Higher efficiency, lower service cost and smaller space requirements*—three good reasons for turning your critical dust collecting jobs over to this remarkable fabric arrester.

Constant air volume is assured by the automatic continuous re-conditioning of the fabric tubes. Reverse jet principle allows velocities through the media up to *five times greater* than ordinary fabric collectors. The compact, factory-assembled AMERjet is easily erected on the job at minimum cost.

AMERjets are available for handling *any* exhaust volume. For complete information, call your local AAF representative or write direct for Bulletin 279. Address: Mr. Robert Moore, American Air Filter Co., Inc., 326 Central Avenue, Louisville, Kentucky.

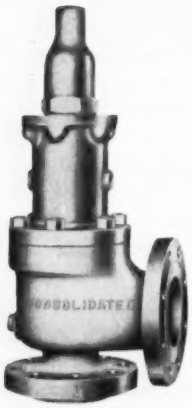
AAF American Air Filter

BETTER AIR IS OUR BUSINESS



PRESSURE EVACUATOR

improves valve operation and performance



Consolidated Safety Relief Valve, Type 1900 Series, Sizes: 1" x 2" to 8" x 10".

The Eductor Tube in Standard Consolidated Safety Relief Valves is a pressure evacuator. It efficiently removes pressure from the closed bonnet. If allowed to remain in the bonnet, the pressure would act on the top of the disc and tend to limit the lift and induce cycling. But with the pressure evacuated from the closed bonnet through the Eductor Tube, the spring alone controls valve action. Consequently, *reliable* valve action and guaranteed capacity ratings are attained. A new high in operational dependability is assured.

Reliable operation and performance of Consolidated Safety Relief Valves are your assurance of absolute protection for personnel and equipment. "2 in 1" design permits you to convert the Standard valve to the Bellows type in your own shop. But that is only part of the total economy of these modern valves. Get the complete inside story. Write for Catalog 1900.

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A product of

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Consolidated Ashcroft Hancock Division • Tulsa, Oklahoma
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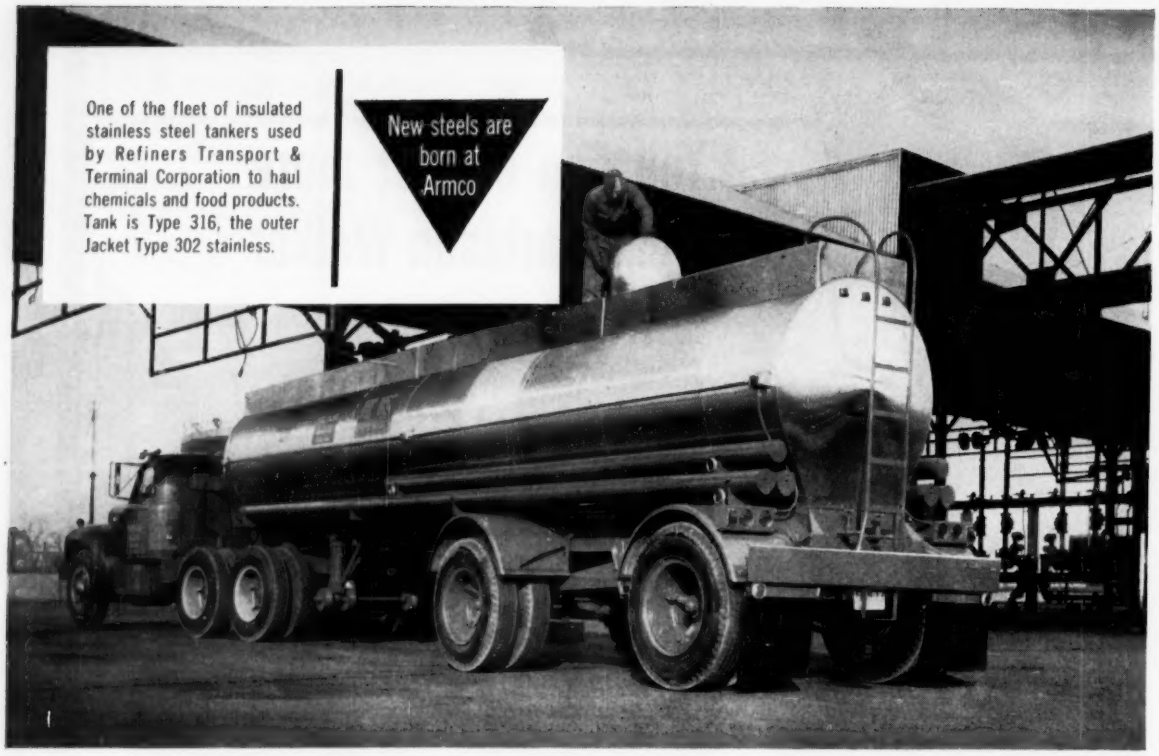


Stainless Steel Tank Trucks Cut Shipping Costs for Wide Range of Chemicals

Midwest transporter demonstrates economy and versatility of stainless tankers for contaminant-free shipment of phosphoric acid, formaldehyde, ammonia, phthalic anhydride, paints, detergents, resins and vodka.

This partial list of the variety of chemical and food products hauled in stainless steel tank trucks by Refiners Transport & Terminal Corporation of Detroit, is indicative of the increasing use of stainless transportation equipment by chemical producers.

Stainless tankers for shipment of chemicals in quantities of about 1000 to 6000 gallons not only cut shipping costs but assure their delivery without contamination. Products like phthalic or maleic anhydride can be safely shipped in the molten state in insulated stainless trucks. This eliminates packaging costs in your plant and saves time and money for the user, because remelting is not necessary.

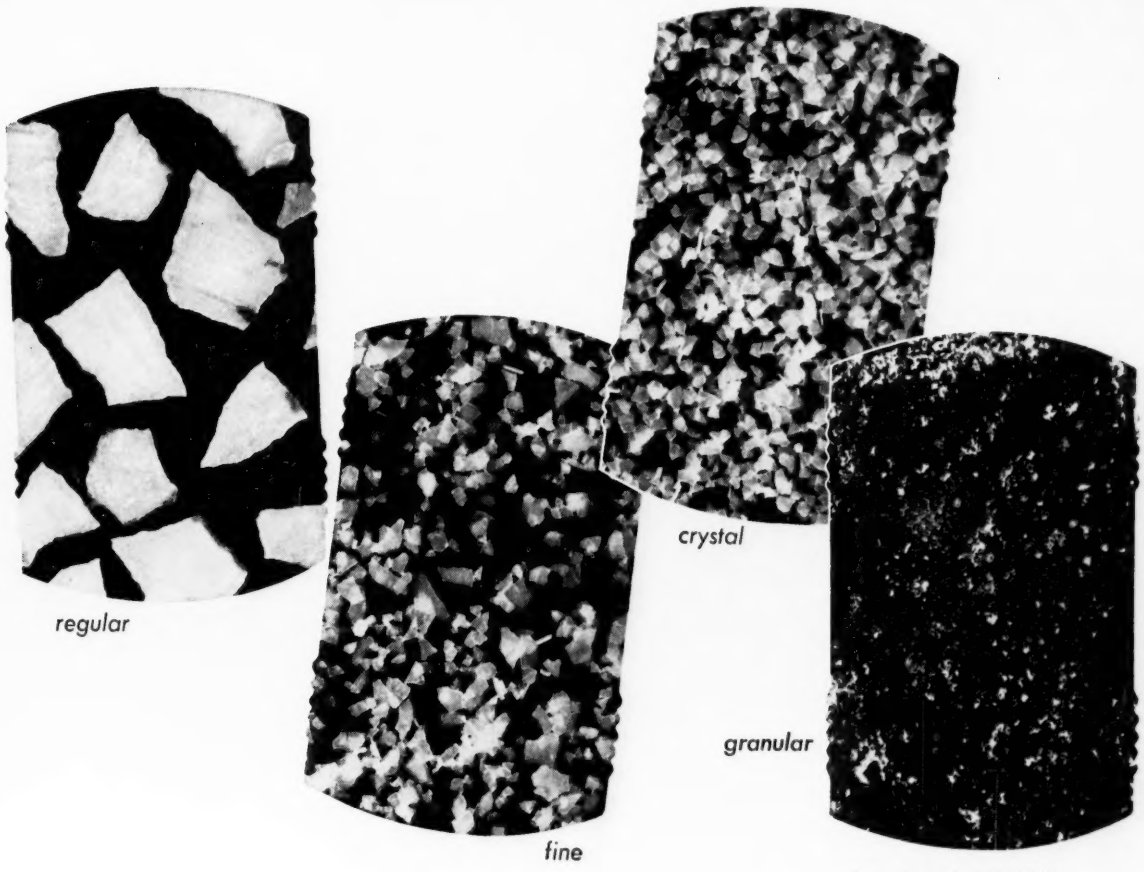
Whether you operate your own fleet or hire a carrier, tank trucks made of Armco Stainless Steel help solve traffic department problems. Because of their excellent corrosion resistance and easily cleaned surface, stainless tankers can be switched from one product to another to keep shipments on schedule.

For low cost, contaminant-free shipment of *your* finished products and raw materials, specify tank trailers made of Armco Stainless Steel. Write for more information. Armco Steel Corporation, 2229 Curtis Street, Middletown, Ohio.

ARMCO STEEL

Armco Division • Sheffield Division • The National Supply Company • Armco Drainage & Metal Products, Inc. • The Armco International Corporation • Union Wire Rope Corporation • Southwest Steel Products

Go Stainless for a Versatile Fleet



photos show actual size of flakes

Flake caustic soda: pick the size that's right for YOU

You have a better than average chance of getting the size that's just right for your product or process when you select from these *four* Hooker caustic soda flakes.

The *Regular, Fine,* and *Crystal* sizes are especially firm and nondusting, thanks to a tightly controlled flaking-screening process. They're just thick enough to take handling abuse or breakdown in transit, just thin enough to dissolve rapidly into solution.

We'll be happy to send you samples and technical data. Write and tell us what sizes you're interested in.

If you use less than carload lots, ask your Hooker jobber to stock the sizes you need. If you are not familiar with the Hooker jobber in your area, we'll be glad to send you his name and address.

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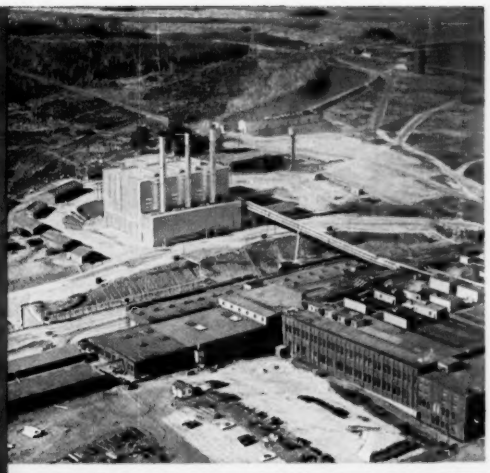
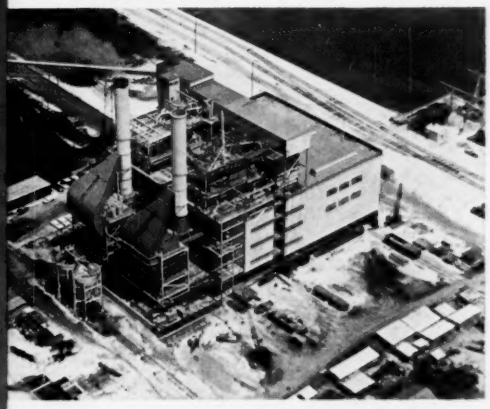
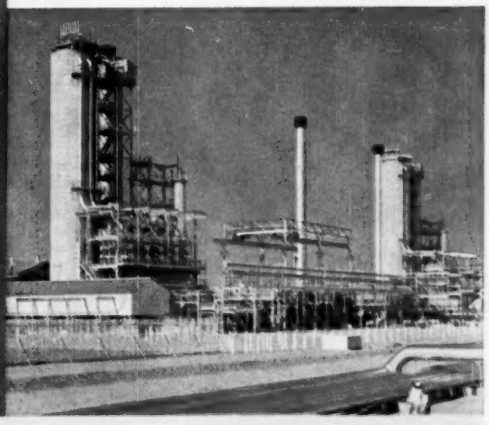
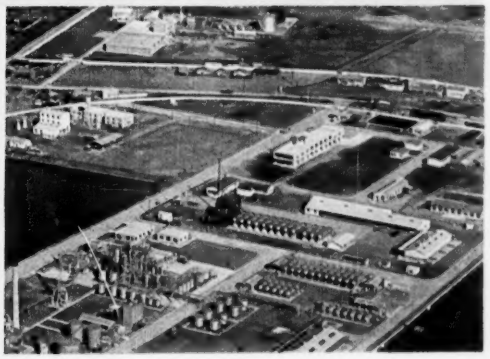
Building today for tomorrow's needs has been Stone & Webster's objective for 70 years. The plants we build today must compete profitably with tomorrow's plants. This can only be achieved by reducing construction and operating costs . . . by scrupulously respecting client budgets and schedules.

If your company is contemplating expansion or actively planning new facilities, let us demonstrate how Stone & Webster's experience can add to your future profits. Call or write our nearest office.









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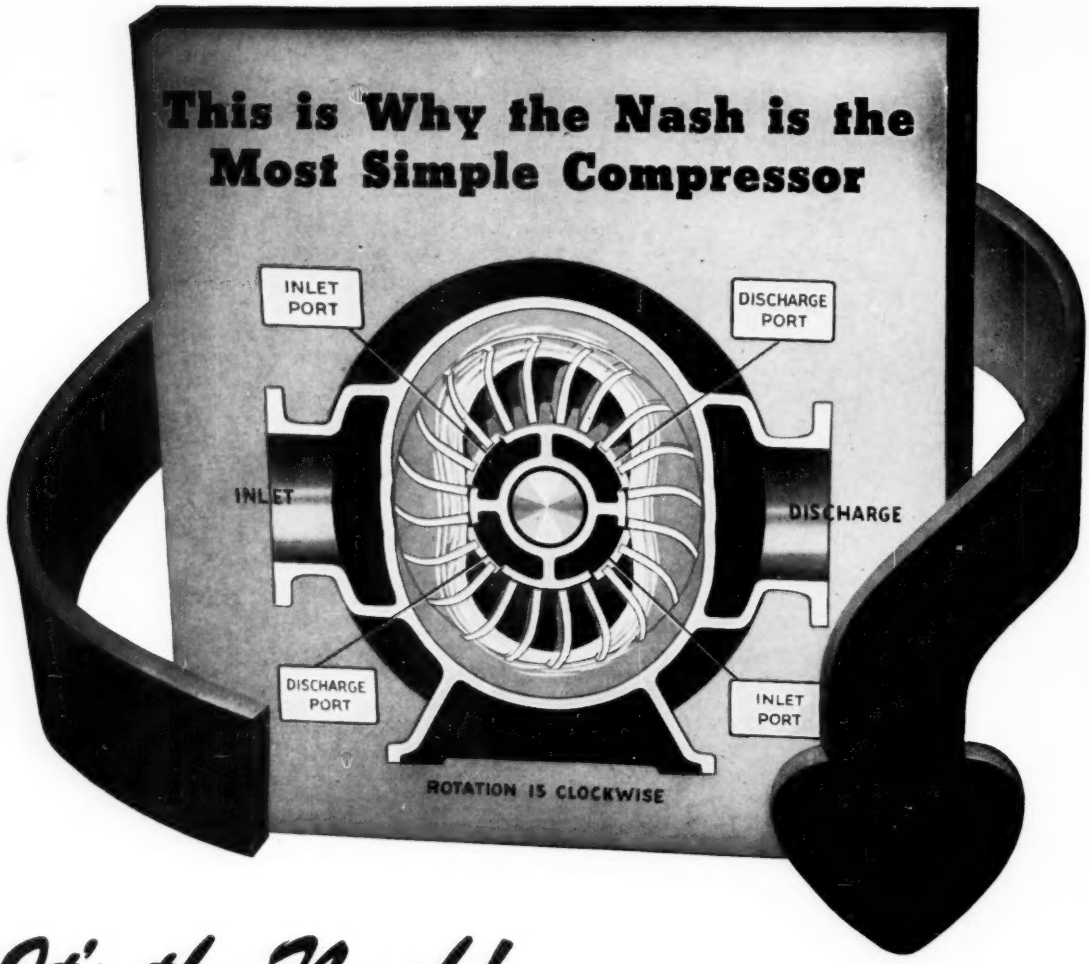
This is Why the Nash is the Most Simple Compressor



It's the Nash!

There are no mechanical complications in a Nash Compressor. A single moving element, a round rotor, with shrouded blades, forming a series of buckets, revolves freely in an elliptical casing containing any low viscosity liquid. This liquid, carried with the rotor, follows the elliptical contour of the casing.

The moving liquid therefore recedes from the rotor buckets at the wide part of the ellipse, permitting the buckets to fill with gas from the stationary Inlet Ports. As the casing narrows, the liquid is forced back into the rotor buckets, compressing the gas, and delivering it through the fixed Outlet Ports.

Nash Compressors produce 75 lbs pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure. Since compression is secured by an entirely different principle, gas pumping problems difficult with ordinary pumps are often handled easily in a Nash.

Nash simplicity means low maintenance cost, with original pump performance constant over long periods Data on these pumps sent immediately on request

No internal wearing parts.

No valves, pistons, or vanes.

No internal lubrication.

Low maintenance cost.

Saves floor space.

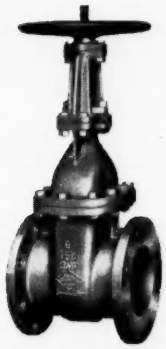
Desired delivery temperature automatically maintained.

Slugs of liquid entering pump will do no harm.

75 pounds in a single stage.

NASH ENGINEERING COMPANY

313 WILSON, SO. NORWALK, CONN.



In this **Split Wedge Gate**

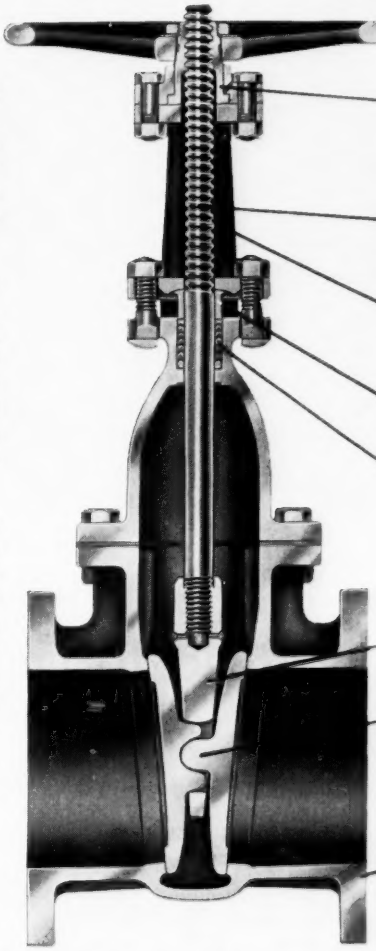
you can see why it pays to

Specify JENKINS for STAINLESS STEEL Valves, too

This picture shows the many points of excellence in the design and construction of Jenkins Fig. 1327 Split Wedge Stainless Steel Gate Valves. Compare them with any valve you know. You'll conclude that it's hard to beat Jenkins at making valves, no matter what the material.

But no picture can show the quality of the castings . . . the precision machining . . . the rigid inspection and testing that have gone into this valve. All of these are as important as design and metal alloys in assuring long, dependable, economical valve service. And, all of them are up to the peak standards for which Jenkins has been known for almost a century.

SEND FOR NEW CATALOG of Jenkins Stainless Steel Valves. You'll find in it the patterns you want, in a choice of alloys that satisfy the requirements of practically all corrosive services. Also, you'll see that these Jenkins valves meet valve industry specifications and the high standards established by the leading users of stainless steel valves. Jenkins Bros., 100 Park Avenue, New York 17.



WHEEL of high strength malleable iron designed for firm grip and easy operation.

YOKE BUSHING, easily renewable. Made of bronze, for ideal thread engagement with stainless steel spindle, to prevent seizing or galling of spindle threads. Bushing of stainless steel is optional.

SPINDLE has long thread bearing surfaces with correct lead for easy, tight closing. Screws into wedge carrier, then secured by a stainless steel pin.

YOKE BONNET has liberal space between yoke arms for easy access to packing box. Precision machined flange face assures uniform contact with gasket for a tight body-bonnet joint.

GLAND consists of two pieces — gland flange and gland follower — eliminates binding of follower in case gland bolts are tightened unevenly.

PACKING of Chevron-type Teflon in large packing box prevents leakage. Only a minimum load is required on gland, extending service life of packing.

WEDGE CARRIER connects wedge to spindle and raises or lowers it. Husky in size to stand any operating strains.

SPLIT WEDGE is the ball-and-socket design which automatically adjusts to the tapered seating surfaces for positive shutoff. The discs, revolving freely in the wedge carrier, produce a self-cleaning action on seating surfaces and reduce possibility of galling and seizing.

BODY —Through-port design for full, free flow. Ample wall thickness and good design provide extra strength to withstand stresses. End flanges conform to M.S.S. specs.

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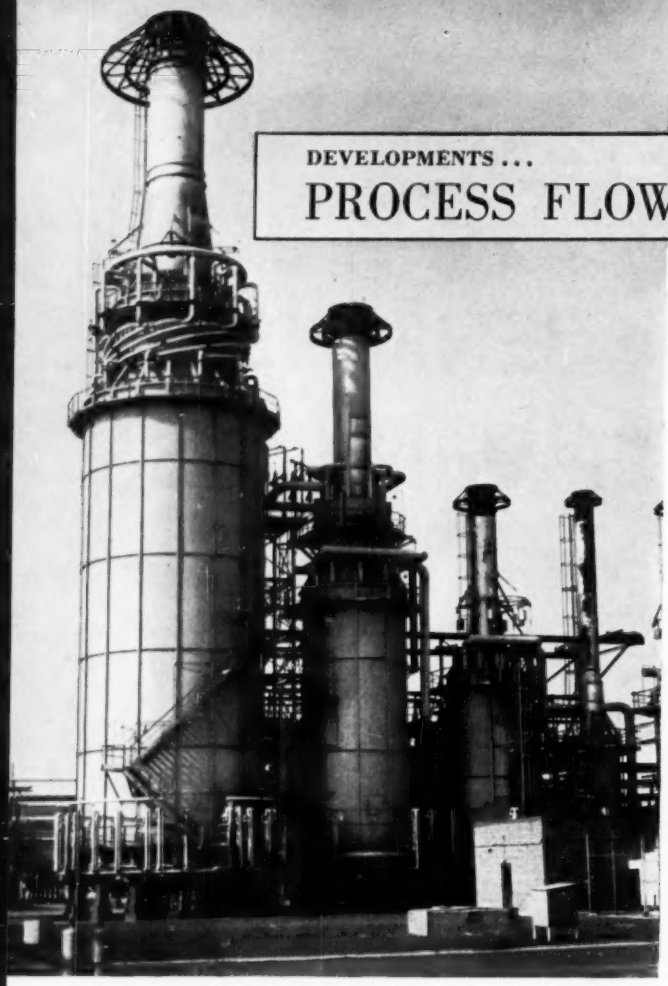
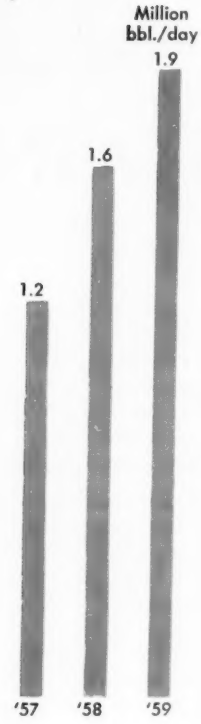


DIRECT-FIRED HEATERS, arrayed in line, preheat charge to reformer and reheat feed between reactors.

Catalytic reforming capacity has nearly doubled over the last three years.



Cat Reforming: Road to High Octanes

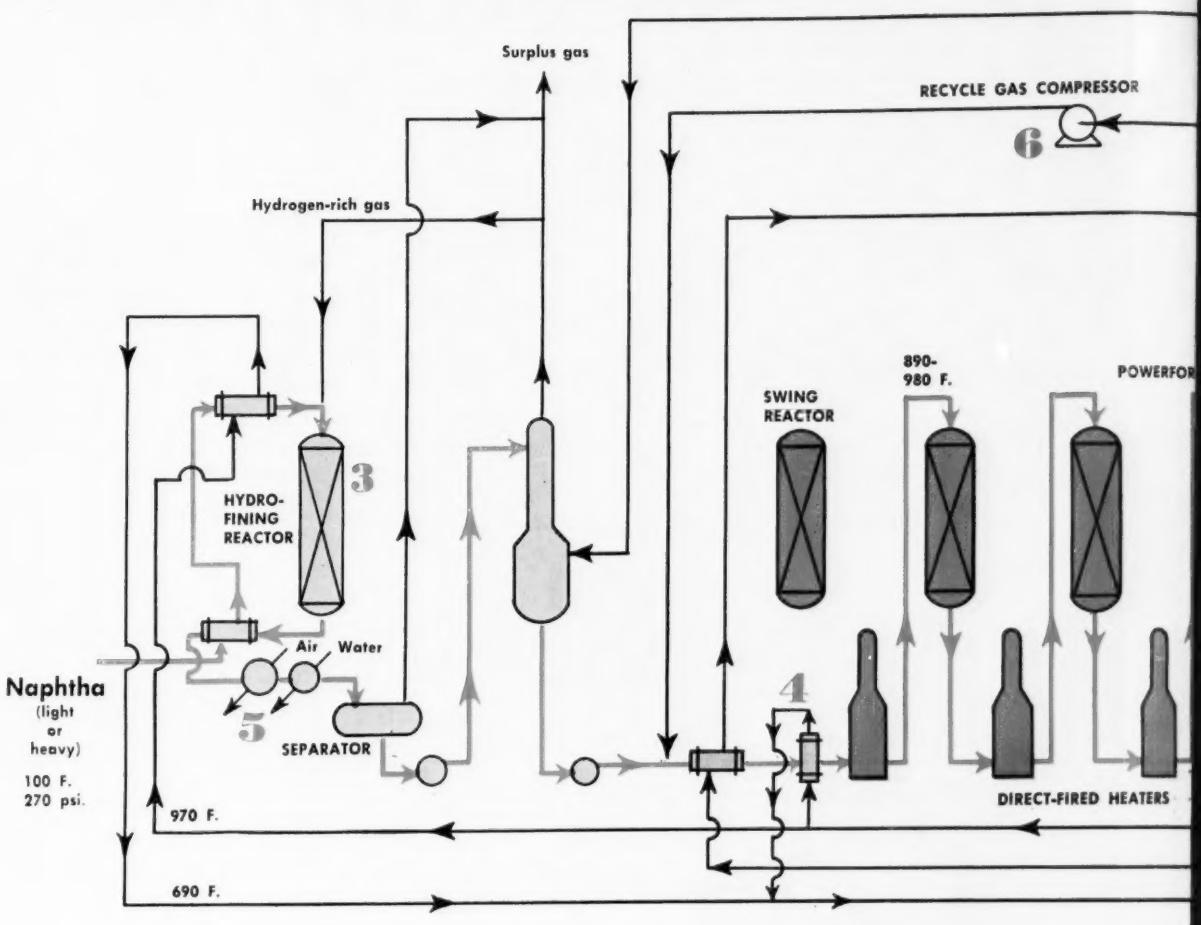
As today's gasolines meet more stringent demands, catalytic reforming processes perform a yeoman service. Esso's Powerforming is one of the latest such routes.

WRENCHING atoms of hydrogen from one molecule and wedging them into another has become an increasingly popular gambit among oil refiners.

The purpose of this molecular switch is to improve the quality of refined petroleum products. Refined products have been feeling a definite squeeze from most markets for higher quality. And catalytic reforming, largely a matter of wrenching hydrogen from molecules, is one process that counts more and more heavily in shaping improved products, primarily refinery gasoline fractions. The rise of cat reforming capacity is averaging an impressive 20% per year.

At present the refiner can select his process from some dozen available for license.

Unfold Flowsheet



Now at work reshaping 20,000 bbl./day of low-octane naphtha into high-octane motor gasoline component is a Powerformer catalytic reforming unit recently placed on stream at Esso Standard's Bayway, N. J., refinery. Powerforming, developed by Esso Research and Engineering, is one of the newer reforming schemes; and, with many technical details now available, Esso's unit offers a close look at a typical such setup.

▶ **Linked in Tandem**—As is the case with so many catalytic reforming units, Esso's links up in a tandem commonly employed: hydrogen treating of feedstock followed by reforming. Esso hydrotreats feedstock (via a hydrofining process developed by Esso Research and Engineering) to remove sulfur, then turns around and reforms this stock, by dehydrogenation and dehydroisomerization of naphthenes with dehydrocyclization of paraffins. Minor reactions are paraffin isomerization and hydrocracking. In all these reactions, temperature determines which one predominates.

Before naphtha enters the Hydrofiner-Powerformer sequence, it goes to a naphtha splitter where it splits into light and heavy fractions which then go to storage. These fractions are charged, in blocked operation, to the Hydrofiner.

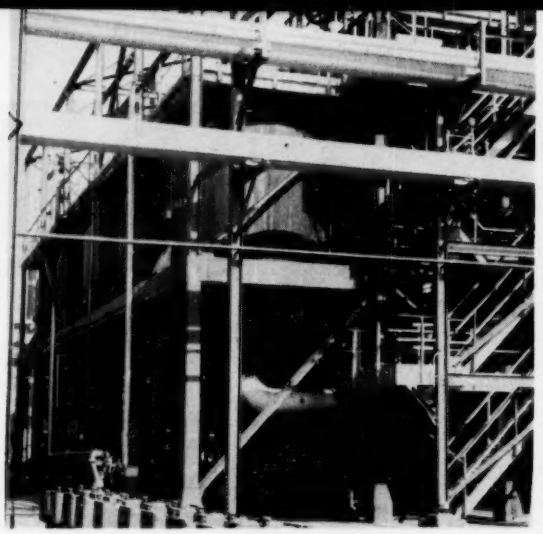
By charging light and heavy fractions separately, Esso gains flexibility in its products; for example, it's often desirable to reform the two fractions to different octane levels under different operating conditions.

The figures below give an idea of the utilities required for Powerforming.

What It Takes to Run a Typical Powerformer[1]

Steam	4,000 lb./hr.
Power[2]	5,000 kw.
Cooling water[3]	7,400 gpm.
Direct fuel	300 million Btu./hr.

1. 20,000 bbl. per stream day. 2. Based on electric motors for all pumps and compressors. 3. Based on 25°F. rise in cooling water temperature. Requirements vary widely, depending on amount of exchange preheat used.



2 REACTORS, usually four "on oil" while one is undergoing regeneration, upgrade low-octane naphthas.

3

▶**First, Hydrofine**—Charge is preheated and vaporized by heat exchange against Hydrofiner effluent, mixed with hydrogen-rich treat gas (Powerformer product gas), and passed through the Hydrofiner containing a fixed bed of cobalt molybdate catalyst.

Hydrofiner effluent is cooled by exchange and by an air cooler, then enters a drum where gas is separated from condensed naphtha. Gas can be used either as fuel or by other Hydrofiners as treat gas. Residual H_2S is stripped from the naphtha before reforming.

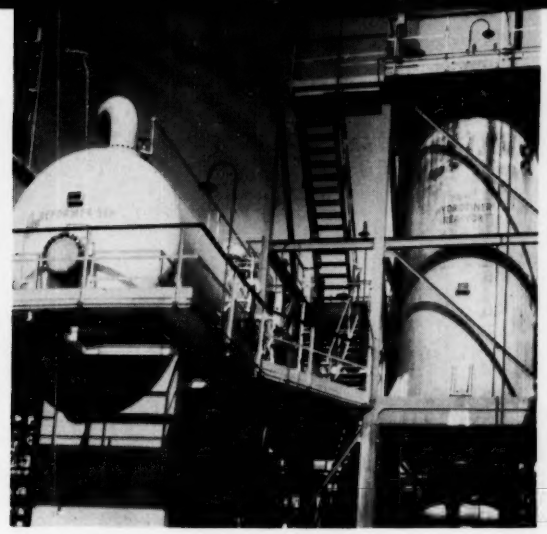
▶**To Powerformer**—Stripped naphtha is mixed with recycle gas from the Powerformer, preheated by exchange and direct-fired heater to 890-980 F. and enters the first reactor. Since recation is predominantly an endothermic process, reheat furnaces are included between the reactors to maintain feed temperatures at 890-980 F.

Vapor effluent from the last reactor is used as heat exchange to heat or cool various process streams and flows finally to a tank where liquid (Powerformate) is separated from gas. Product recycle gas is compressed and returned to mix with the reformer feed.

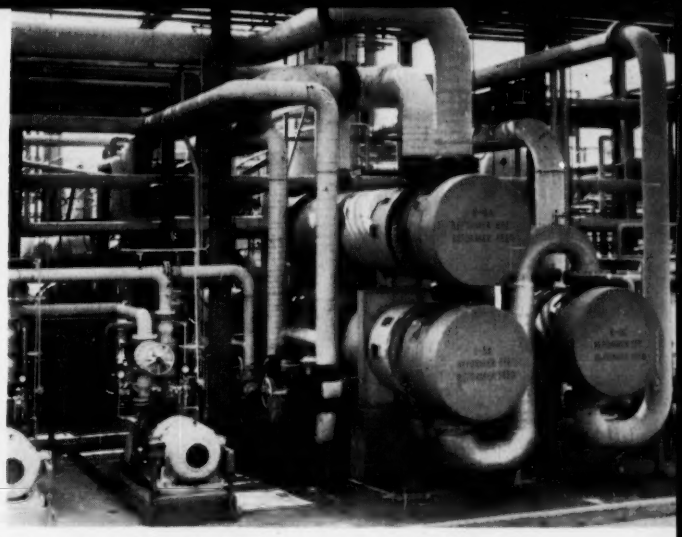
Reactors are fixed-bed and contain a platinum-salt catalyst impregnated on an alumina base. Under present operating conditions, with about 6,000 cu. ft. of recycle gas per bbl. of Powerformer feed, pressure drop across the reactor bed in each of the reactors is 5-20 psi.

▶**Regeneration Helps**—One attractive feature of Powerforming is that spent catalyst in one reactor can be regenerated, using a swing reactor in place of reactor needing regeneration. Processing severity at Bayway is set to produce a debutanized reformate of about 98 clear Research octane. So a regeneration schedule of one reactor a day is enough to satisfy Bayway requirements.

Regeneration, burning off coke from the spent catalyst, is done with a combination of inert gas and air injected in controlled amounts.

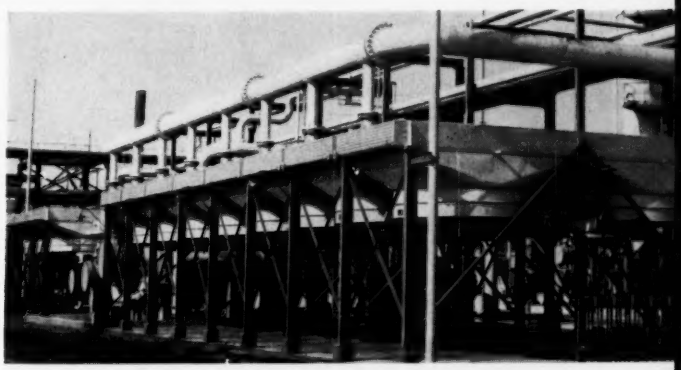


3 HYDROFINER AND SEPARATOR (left and right) remove impurities from charge and separate recycle.

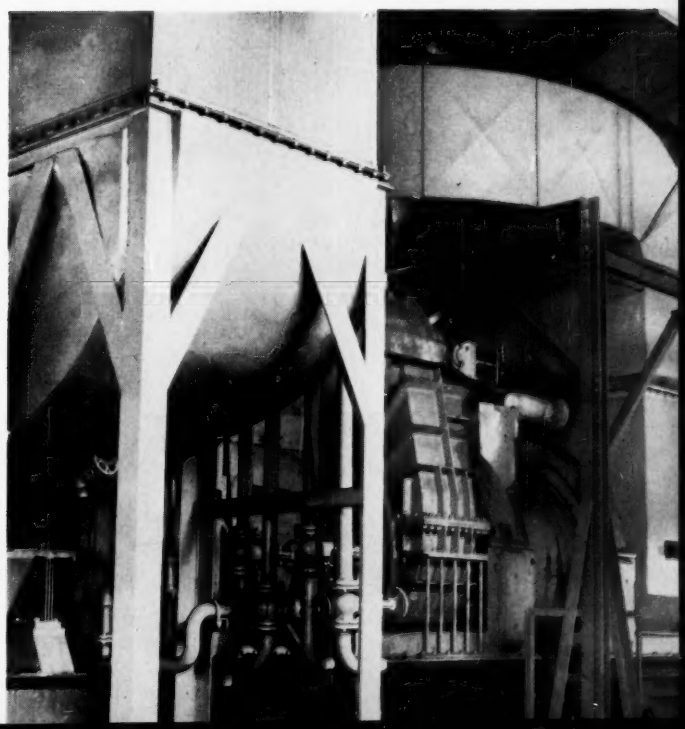


4 HEAT EXCHANGERS above are some of those that use reformer effluent as heat exchange medium.

NIZER



5 AIR COOLER, cheaper here than shell-and-tube exchangers, cools hydrofiner and reformer effluent.



6 RECYCLE-GAS COMPRESSOR is relatively unique in process application (See *Chem. Eng.*, Dec. 29, 1958, p. 19). It is driven by a combustion-gas turbine fueled partly by surplus gas from reforming operation.

NEW! AO 711 SPLASH GOGGLE

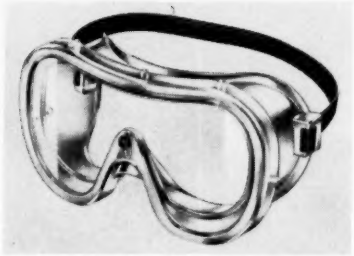
For Positive Protection Against Chemical Splashes!

One New...One Established Goggle...Both Developed in Conjunction with a Prominent Chemical Company

Newest addition to the line, the "711" PROTECTS FOREHEAD, NOSE AND PART OF THE LOWER FACE (as well as the eye area) AGAINST MOLTEN SODIUM SPLASH AND RADIANT HEAT. An ingenious part of the nose section is a plastic hook to which a fireproof cloth can be attached for protecting the face and neck. The crescent-shaped plastic extension over the forehead is as wide as the basic goggle and provides about an inch and a half of extra protection for this area of the brow.

An important feature is the indirect ventilation. Designed without vents in frame, the goggle (like our model 710 below) is twice as fog-free as similar conventional goggles. The "711" is similar to our "710" in all other particulars. It has a soft vinylite mask . . . wide angle vision for safety and greater working efficiency . . . .050" thick plastic lens . . . and provides a perfect fit over personal and Safety B glasses. All parts are replaceable.

This goggle is more general in its application than the "711" and is designed for eye protection solely. It is particularly recommended for use in chemical operations and where humidity is a problem against splashing liquids, spray and the impact of flying particles. Light in weight. Available with clear or green lenses.



ESTABLISHED! AO 710 SPLASH GOGGLE

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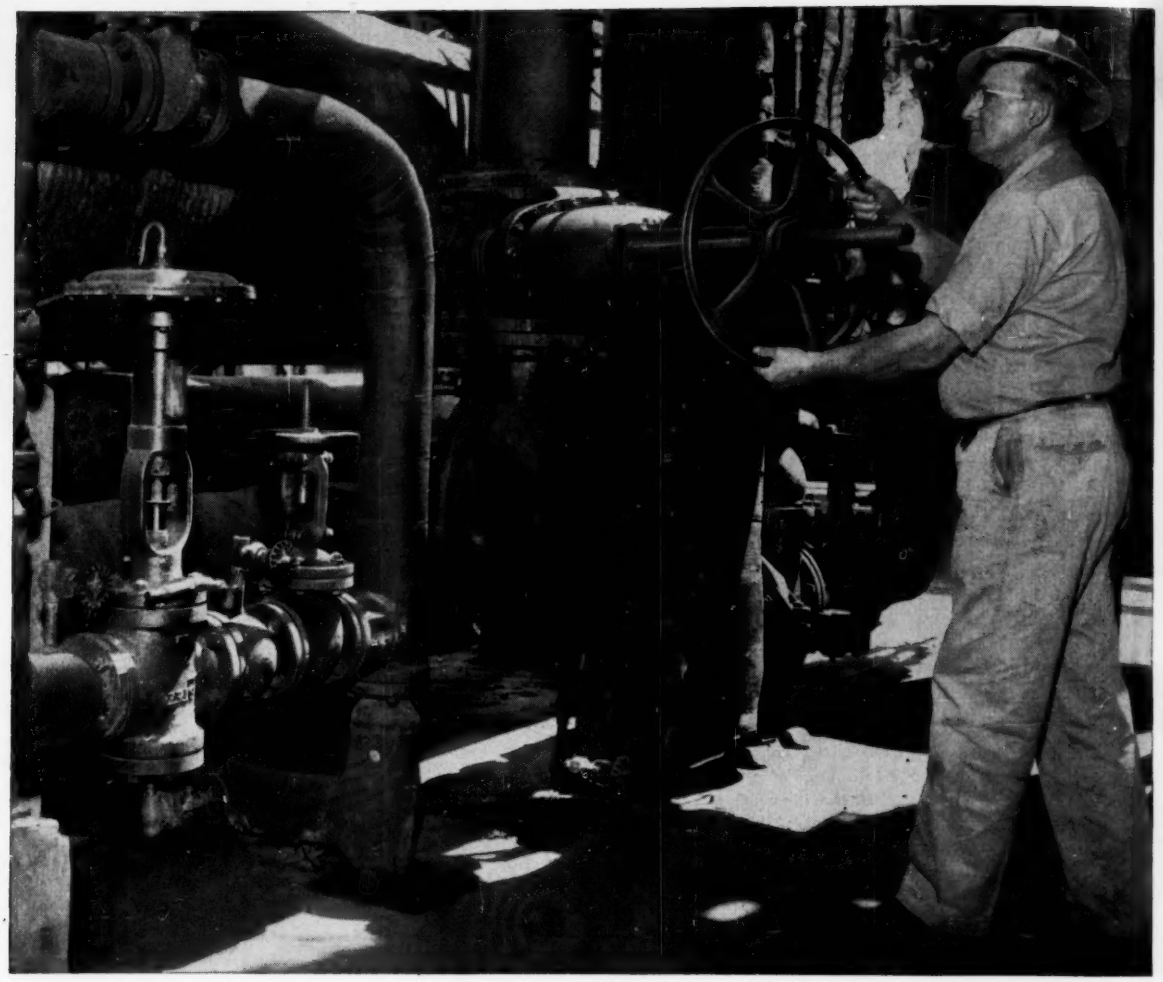


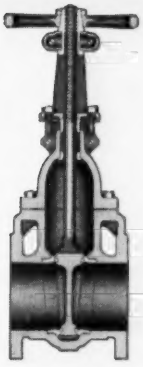
17 years on M. E. A.* solution . . . this Crane iron valve still holding tight

The facts: 17 years on hard-to-hold *Mono-ethanol-amine solution at 250 F with no leakage. No repairs or maintenance to date. Working as good as new.

That's what the Commercial Solvents Corp. petrochemical plant at Sterlington, La., reports on this 12-in. Crane No. 475½, 125-Pound, all-iron wedge gate valve. It is used as a block valve on the M.E.A. process unit, and operated on yearly turn-arounds or if a leak should develop in the unit.

This example is typical of the dependable performance of Crane iron body wedge gate valves. Their durable, low-cost service results from Crane features such as an extra number of bonnet bolts for uniform gasket loading and tight joint; full-length disc guides that save seat surface wear; shoulder-type body rings that can't come loose; extra deep, non-binding stuffing box design.

Ask your Crane Representative for more details on these better service iron body gate valves. They can save you a lot of maintenance dollars.



Cross section, 125-pound iron body gate with flanged ends, outside screw and yoke. Available in all-iron or bronze-trimmed. Line includes non-rising stem valves; also screwed and hub ends. Sizes 2 to 48 in. See your Crane catalog.

CRANE® VALVES & FITTINGS

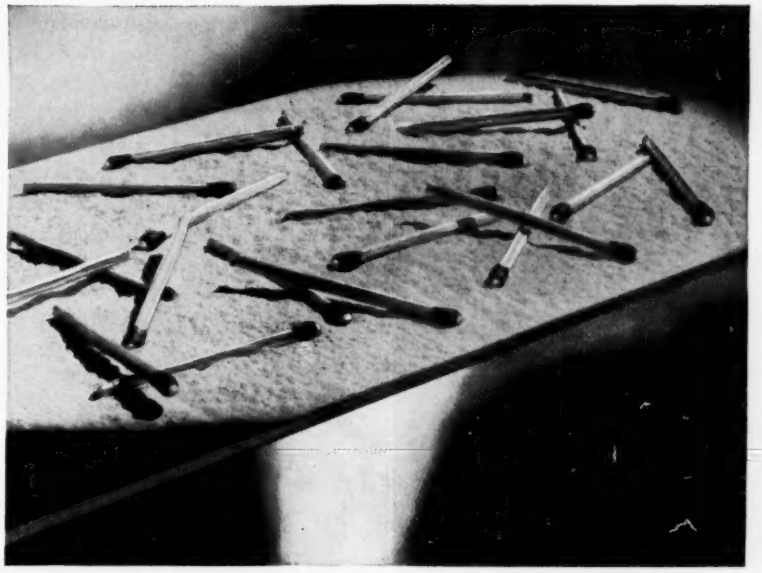
PIPE • PLUMBING • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Illinois—Branches and Wholesalers Serving All Areas

MgO spells opportunity

IMC reports on another outstanding property of its new High Purity MgO—remarkable heat resistance.

For many years, International's potash mining and refining operation at Carlsbad, New Mexico, has been producing large amounts of by-product magnesium chloride brine in conjunction with potassium sulfate. We are recovering values from this magnesium chloride by thermal decomposition to produce magnesium oxide. The product is better than 99% pure — highest purity ever achieved in carload lots.



Unbounded application

Heat resistance is one standout property. As a result, a firm is presently experimenting with it to develop a rocket nose cone capable of re-entering the earth's atmosphere. Another of its chief virtues is ease of handling, due to its low hydration rate.

Using MgO as an addition or substitution, many chemical process industries have been able to impart desirable — and hitherto unattainable — properties to their products. To elaborate:

- Improving the physical and chemical characteristics of magnesia has resulted in substantial savings. Using MgO as an extender, it's possible to obtain a high purity blend at low cost.
- Chemical manufacturers are making high-purity magnesium salts and chemicals from International magnesium oxide because of its relatively low cost and easily controlled reaction rates.
- By replacing ordinary alkali precipitants with MgO, several plants have been able to increase their process efficiency and reduce production costs.

Among its other applications: Electric furnace fusion for high temperature applications . . . in high-grade ceramic and glass formulations . . . for acid neutralization and uranium ore treatment . . . in thermocouples . . . as a substitute for alumina. Due to its low boron content, this International product has been the main source of MgO for U.S. Atomic Energy Commission applications. And the limits of its potential are nowhere in sight.

Send for a sample

If you're interested in the possibilities of high-purity MgO in your operations . . . if you detect promise for its use as a replacement material or in an entirely new application — use the coupon below. Our research staff is prepared to explore end-use problems with you. We will be happy to furnish adequate samples for experiment, and to supply technical assistance where required.

22-59

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Buyers Guide to Ryerson Stainless Stocks & Services

Here's a quick guide to the nation's largest stocks of stainless steel—2,351 sizes, shapes, types and finishes of stainless in stock at Ryerson.

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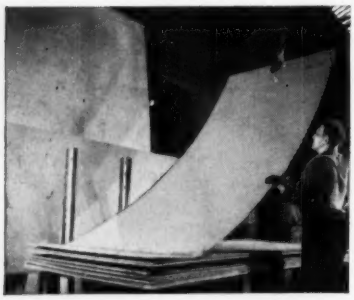
See your Ryerson catalog for a complete listing of stocks and call your nearby Ryerson plant for quick shipment of stainless—any type or size—one piece or a truckload.



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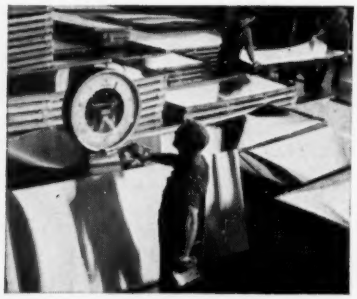

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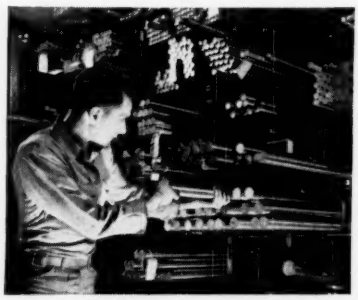

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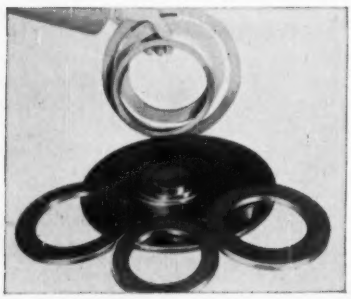

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JUNE 1, 1959

The Theory Behind

Static Electricity Hazards

in Process Plants

D. I. SALETAN, Engineering Dept., Shell Chemical Corp., New York.

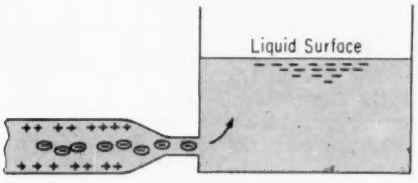
HIGH pumping rates, highly refined products, increased volumes, have all focused attention on a long ignored process problem: the electrostatic origins of fires and explosions.

Most of the mechanisms on how static electricity accumulates and discharges have been recently worked out for the petroleum industry. These mechanisms are basically the same for chemical processing, although there are some differences in physical and chemical properties of the materials involved.

We will attempt here to answer the questions of just how static electricity can build up and how much will cause trouble.

The key to understanding these phenomena lies in appreciating the difference between charge and voltage. Charge and voltage are geometrically interrelated but they are no more the same thing than are volume and pressure.

At the boundary between any two coexisting



phases there will usually be a lineup of opposing electrical charges, one set of charges in one phase, the other set in a very closely adjacent phase. (This Helmholtz double-layer theory has been considerably elaborated by the findings of modern physics, but is adequate in its crude form for an understanding of what is involved.) The small but discrete separation between these two layers of opposite charge leads to a voltage differential, a so-called contact (zeta) potential at the interface. This contact potential is only of the order of 0.01 to 0.1 volt when one of the phases is liquid, and is not noticed in usual operation.

How Static Electricity Builds Up

However, suppose one of these phases is fixed in space and the other phase begins to move past it. Some of the charges formerly in close apposition to their opposite number in the fixed phase will be sheared off and move into the main stream of the moving phase. Charges formerly only Angstrom units apart have now been separated by a matter of inches or feet. The result can be a very large magnification of the voltage differential involved. If the fixed phase is the inside wall of a pipe and the moving phase is an organic liquid being transferred through a pipe into a large tank the picture is very much as shown in the figure to the left.

If the pipe is an electrical conductor (as it normally is) and long enough, an electrical dynamic balance will soon be set up where charges sheared off upstream find their way back to the wall downstream and then by conduction through the pipe wall are able to restore the condition of electrical neutrality. Under these conditions, the voltage differential between the body of the moving fluid and the wall of the pipe (which we assume to be at ground potential) cannot become very large.

Now consider the situation when the detached charges are propelled through the tank inlet into the central body of the liquid contents of the tank. Instead of having to traverse a matter of inches to reach the grounded metal wall of the pipe they must now pass through

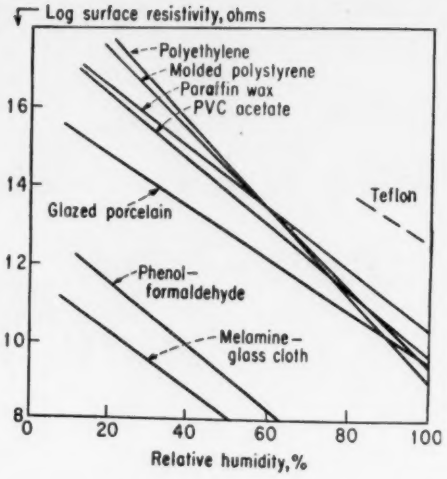
a considerable body of liquid, which may have a high electrical resistance, before reaching the grounded tank wall. The streaming current, representing the rate at which charges are sheared off and then returning to the pipe, can be related[1, 8] to the physical situation by the following equation

$$I = \frac{A\epsilon\zeta}{L\mu}\Delta P$$

A key item of interest in this equation is the streaming current is proportional to pressure drop per unit length, irrespective of whether we have laminar or turbulent flow.* For appropriate values of pipe cross-section, liquid dielectric constant, liquid viscosity, pressure drop per unit length, and the contact potential, zeta, the streaming current calculated from the above relation may amount to as much as 10^{-5} amp. This may not seem like a large figure but it can lead to very large buildups of voltage in the center of the tank after this current is propelled into that region. For example, if the effective leakage resistance to ground from the center of the tank were of the order of 10^{10} ohm, as it very well might be with a nonconductive fluid, resulting voltage buildup might be in the order of 100,000 volts.

Another situation in which phase separation can lead to accumulation of electrostatic charge is in the settling out of a dispersion of a conducting phase in a nonconducting phase, such as water in hydrocarbon. In this case, the double layer is at the surface of the water droplets. The settling motion of the droplets displaces the charges within the droplets with respect to the opposing charges in the bulk of the nonconducting liquid. Individually, charges on these droplets are rather small. But the cumulative effect of the settling out of a large number of droplets is to produce a sizable voltage differential between the body of nonconducting hydrocarbon upper layer and the water layer at the bottom, which we assume to be at ground potential.

The key point here is that the continuous phase is relatively nonconducting; otherwise charge will drain off rapidly relative to its segregation by settling.



Humidity Increases Solid Conductivity **Fig. 1**

Humidity plays an important role in electric charge buildups on the surface of nonconducting solid materials. The figure above shows this effect. A change in humidity from 50 to 70% produces a 1,000 fold increase in surface conductivity. This is due to an adsorbed film of moisture on the solid surface, providing a conductive path.

* In the case of hydrocarbons in fully-developed turbulent flow this does not hold, because the assumption of a compact electrical double layer is no longer valid. In such case the streaming current becomes proportional to velocity.[8]

Nomenclature

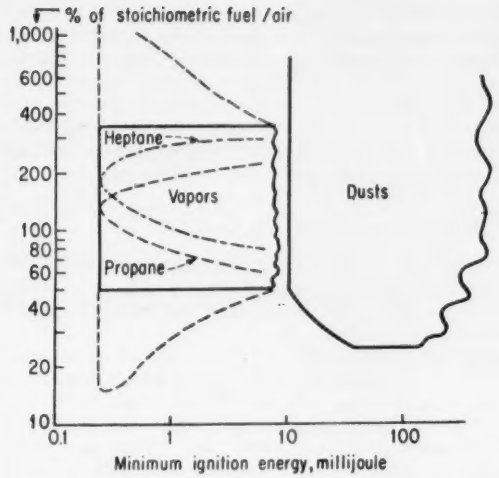
A	Pipe cross-section, sq. cm.
b	Proportionality constant.
C	Capacitance, farad.
I	Current, amp.
L	Pipe length, cm.
P	Pressure, dyne/sq. cm.
Q	Electrostatic charge, coulomb.
R	Electrical resistance, ohm.
V	Voltage, volt.
W	Energy of an electrical discharge, joule.
x	Volume fraction disperse phase.
ϵ	Dielectric constant (dimensionless ratio).
ϵ_o	Absolute dielectric constant of a vacuum = 8.85 x 10^{-14} sec./ohm-cm.
ζ	Contact potential, volt.
κ	Electrical conductivity, mho./cm.
μ	Viscosity, poise.
μ_f	Microfarad.
ρ	Electrical resistivity, ohm-cm.
τ	RC = relaxation time constant, sec.

Measure Ability to Store Charges

Up to this point, we have been calculating buildup voltages by an Ohm's law approach; voltage equals current times leakage resistance to ground. However, we have another property to deal with: capacitance, that is, the ability to store charges.

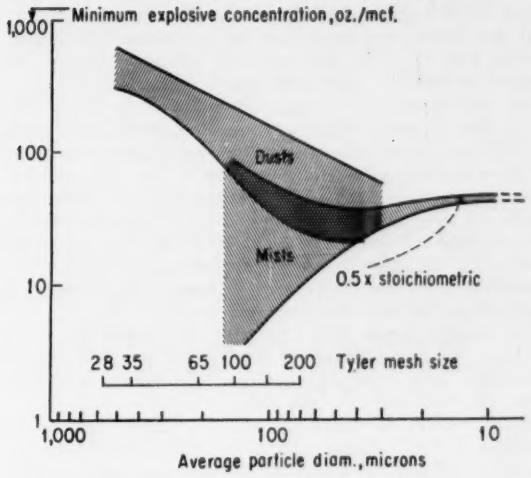
Assume, for example, that the streaming current enters a tank at a constant rate. The steady-state voltage given by Ohm's law will only be obtained after a sufficiently long period of time. Thus, the effective capacitance to ground may be regarded as fully charged. The product (RC) of the resistance to ground (R) and the capacitance to ground (C), has the units of time and provides a direct measure both of the time required to approach the steady state voltage and of the time required for the charge to leak off after the streaming current has stopped. The RC constant is, therefore, a valuable figure to know in a given geometrical situation and often can be directly calculated or at least estimated with order-of-magnitude precision.[2, 7, 8, 11]

In some cases, where rapid transfers of liquids into tanks are dictated by economic reasons, it is possible to substantially lessen the electrostatic hazard by providing "relaxation" in an enlarged section of pipe just prior to entering the tank. Residence time in this relaxation section need be only of the order of twice



Regions Where Fuel/Air Mixtures Explode Fig. 2

Dusts belong in the same explosive picture as vapors. The above figure shows the hazardous region for both, in terms of explosive concentration limits, and minimum ignition energies. The square region embracing the curves for heptane and propane is the hazardous area for these two vapors. Other materials show wider limits (dotted lines outside).



Consider Particle Size Effect Fig. 3

Particle size can greatly affect the minimum explosive concentration of dusts and mists. Very fine particles (less than 50 microns) behave like vapor fuels. With increasing mist droplet size, the lower limit drops, due to a sedimentation effect. Dusts show no such effect; minimum explosive concentration decreases with decreasing particle size.

the *RC* time constant for the liquid. Note that the *RC* time constant is a function only of liquid resistivity and dielectric constant, as long as the capacitive and resistive paths to ground occur primarily through the bulk of the liquid. The table shows how the time constant varies with fluid properties.

$$\tau_{sec} = R_{ohm} \times C_{farad}$$
$$= 8.8 \times 10^{-14} \epsilon \rho_{ohm\text{-}cm.}$$

for $\epsilon = 2.2$:

$\rho_{ohm\text{-}cm}$	10^{10}	10^{12}	10^{14}	10^{16}
τ_{sec}	0.002	0.2	20	2,000

If the walls of the pipe or tank are not grounded, charge buildup and an accompanying voltage buildup can reach much higher values, limited only by leakage and electrical breakdown strengths. In such cases the resistance governing relaxation time may not be that of the fluid inside the container. Nowadays, operating people are sufficiently well aware of potential hazards to install grounds on pipes, tank walls and other metal objects in electrostatic situations. However, if the tank wall or pipe is made of a nonmetallic material with a very low electrical conductivity or if there is some resinous lining used it is difficult to effectively ground the container walls.

Humidity Provides Conductive Path

Humidity can play a significant part in determining leakage times in the relaxation period, particularly when we are speaking of charge buildups on the surface of nonconducting solid materials.

This leakage is not due, as is popularly supposed, to any significant change in the properties of the atmosphere. Rather it's due to an adsorbed film of moisture present at high humidity on the surface of most solids, providing a more conductive path to ground than through the bulk of the solid (Fig. 1).[5]

It's possible to modify the conduction of the atmosphere itself by the use of gamma rays or other emissions which actually increase the number of ionic particles in the air.

Explosive Limits for Vapors, Dust

For each combustible vapor there is a lower and an upper concentration limit beyond which combustion will not be self-propagating. As a crude generalization, these limits are respectively 50% and 300-400% of the stoichiometric proportion of vapor in air.* These boundaries are somewhat variable—stronger sparks tend to widen the explosive limits.

A value of 0.2 mj., which is the lowest energy spark known to initiate an explosion, actually applies only at concentrations relatively close to the stoichiometric mixture. Outside the so-called upper and lower limits, energies on the order of 5 or 10 mj. are required.

Up to this point we have been speaking only of va-

*The terms "flammability limits" and "explosive limits" have been used interchangeably.[4, 6]

pors in air as combustible media. However, in chemical operations we have come to recognize that liquid mists and dusts in air can also readily function as explosive media. Although energies required for ignition are somewhat larger for mists and dusts, and explosive pressures in general develop more slowly than for vapor explosions, mist and dust explosions must still be considered quite hazardous. They also exhibit the phenomenon of the lower explosive limit, although here we must speak of weight of fuel per volume of air instead of volume percent. By relating explosive limits to the stoichiometric proportion it is possible to bring mists and dust clouds into very much the same picture as we have developed for vapors (Fig. 2).

Although upper and lower limits have been published[4] for a great number of chemical compounds, the detailed locus relating explosive concentration limits and ignition energy has been experimentally determined for only a relatively few.[9, 10] Curves are shown in Fig. 2 for propane and heptane. Butane, pentane, hexane and diethyl ether, which have also been studied, would be intermediate between these curves.

Because of the many uncertainties involved it seems best to take the square envelopes shown embracing these curves as an expression of the hazardous region. Even so, there are a few "bad actors" such as hydrogen, carbon disulfide, ethers, which show abnormalities in explosive concentration limits.

Dusts in general require higher ignition energies, 10 mj. being about the lowest observed. The lower explosive limit is dependent upon the fineness of the dust particles and upon the spark energy. However, in many cases, it does seem to be lower than the corresponding lower limit in the vapor concentration situation, about 25% of stoichiometric against 50% for a vapor fuel.

The hazardous region for mists is not shown, because of scarcity of data on minimum ignition energies, but it appears to lie intermediate between those for vapors and dusts. In estimating hazards, therefore, with order of magnitude precision, take 0.1, 1, and 10 mj., respectively, as the minimum ignition energies for vapors, mists, and dusts in air at ambient temperatures and pressures. However, when talking about mists and dusts, you must consider particle size.

How Particle Sizes Affect Limits

Sufficiently fine mist particles, less than about 50 microns in diameter, behave very much like vapor fuels, with a lower limit approximately half the stoichiometric concentration.

Depending upon the proportion of oxygen or halogen in the organic molecule, this means a minimum explosive concentration of about 45 to 60 oz./1,000 cu. ft. air. However, at increasing droplet size, the lower limit actually decreases (Fig. 3). This has been plausibly explained[2, 12] as a sedimentation effect; that is, since these tests are usually run with upward propagation of flame, sedimentation of droplets downward with respect to the flame front produces an effective concentration of fuel in the flame front higher than the measured average concentration of fuel droplets. As we reach relatively coarse particles larger than 100 mesh, the lower limit rises steadily—presumably because the reduced surface per unit mass makes much of the fuel unavailable for rapid burning.

In the case of dusts the sedimentation effect is not as important. Minimum explosive concentrations decrease rapidly with decreasing particle size until about 200 mesh; finer particles have a lower limit of roughly 25-40% of stoichiometric.[6]

A number of solid organic chemicals investigated by the U. S. Bureau of Mines appear at least as hazardous as the earlier-publicized coal, flour, sugar and sulfur dusts.

It is only fair to note that lower explosive concentrations for mists and dusts are usually determined not with modest 1 or 10 mj. sparks but with much more potent sources such as open flames or continuous arcs, thus overstating somewhat the hazardous range as far as electrostatics is concerned. But mists and dust clouds offer an additional hazard. They are frequently created by the very action of agitation which produces an electrostatic concentration and discharge.

Meet Your Author

D. I. SALETAN *was born in New York City and received his chemical engineering training at Cooper Union and the University of Michigan. He began work with Shell Chemical at the the Martinez, Calif., plant in* 1950. *He is now with Shell Chemical's Engineering Dept. in N. Y., specializing in the application of advanced engineering techniques to design and plant problems.*

This is the first of two articles by Mr. Saletan on electrostatic hazards. The second article, which will appear in a forthcoming issue, will discuss specific hazardous chemicals and typical plant operations that can cause trouble.

Based on a paper given at an All-Day Symposium N. Y. section, A.I.Ch.E, Oct. 23, 1958.

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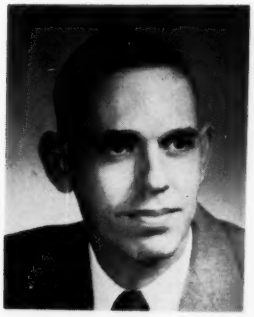
Minimize Computation in Your

Process Piping Designs

Three nomographs make it easy to find pressure drop, pipe size or flow rate; trial-and-error is done entirely by chart.

THOMAS H. ARNOLD, JR., Assistant Editor, Chemical Engineering.

IT'S BEEN estimated that half the total design man-hours spent on an engineering project is for process piping design. One of the tedious parts of piping system design is calculation of pipe sizes, fluid flow rates and pressure drops. Quantities such as Reynolds numbers, friction factors and roughness factors are related and interrelated to the fundamental variables by complex exponential equations or graphs. As a result, in many cases our design problems call for a series of time-consuming trial-and-error calculations.



THOMAS H. ARNOLD, JR., *joined* CE's *editorial staff as an assistant editor in* 1957. *When next you hear from him it will be as Southwestern Editor, working out of Houston, where he will transfer shortly to replace J. A. Lee who retires this summer. Tom hails from Louisiana, with BS and MS in ChE from LSU. His experience has been in petroleum refining, petrochemicals and sugar.*

Here are nomographs made from the basic fluid flow equations, incorporating the friction factor-Reynolds number relationship as part of one of the nomographs. To solve for any of the three unknowns of fluid flow in pipes—pipe size, flow rate and pressure drop—the intermediate step of calculating Reynolds numbers N_{Re} and finding friction factor f is eliminated. No exponential equations must be solved; in fact, the only mathematical operations required apart from the nomographs are simple slide-rule multiplication and division.

Basis of Nomographs

The Darcy-Weisbach equation,[4] the Reynolds number equation and the equation relating flow rate, velocity and pipe size were converted to engineering units and used for the nomographs. The graph of Moody[1]—friction factor vs. Reynolds number—has been made an integral part of the main nomograph, Fig. 1.

Besides the Moody graph, Fig. 1 solves these equations:

$$N_{Re} = 378.9\left(\frac{q}{d}\right)\left(\frac{\rho}{\mu}\right)$$

$$f = 82.76\left(\frac{\Delta P}{L\rho}\right)\left(\frac{d^5}{q^2}\right)$$

Due to the construction of Fig. 1, it's not necessary to read either N_{Re} or f. Values of ϵ/d, relative roughness, are marked on the graphical portion of the nomograph.

To get a first approximation of q or d (when one or the other is unknown and trial-and-error is required), an equation relating N_{Re} and f has been assumed and is the

Nomenclature

N_{Re}	Reynolds number.
q	Flow rate, cu. ft./min.
d	Pipe diameter, in.
ρ	Fluid density, lb./cu. ft.
μ	Fluid viscosity, centipoises.
f	Friction factor.
ΔP	Friction pressure drop, psi.
L	Pipe length, ft.
V	Fluid velocity, ft./sec.
ϵ	Pipe roughness factor, in.

Use This Chart for Finding Pressure Drop, Pipe Size and Flow Rate

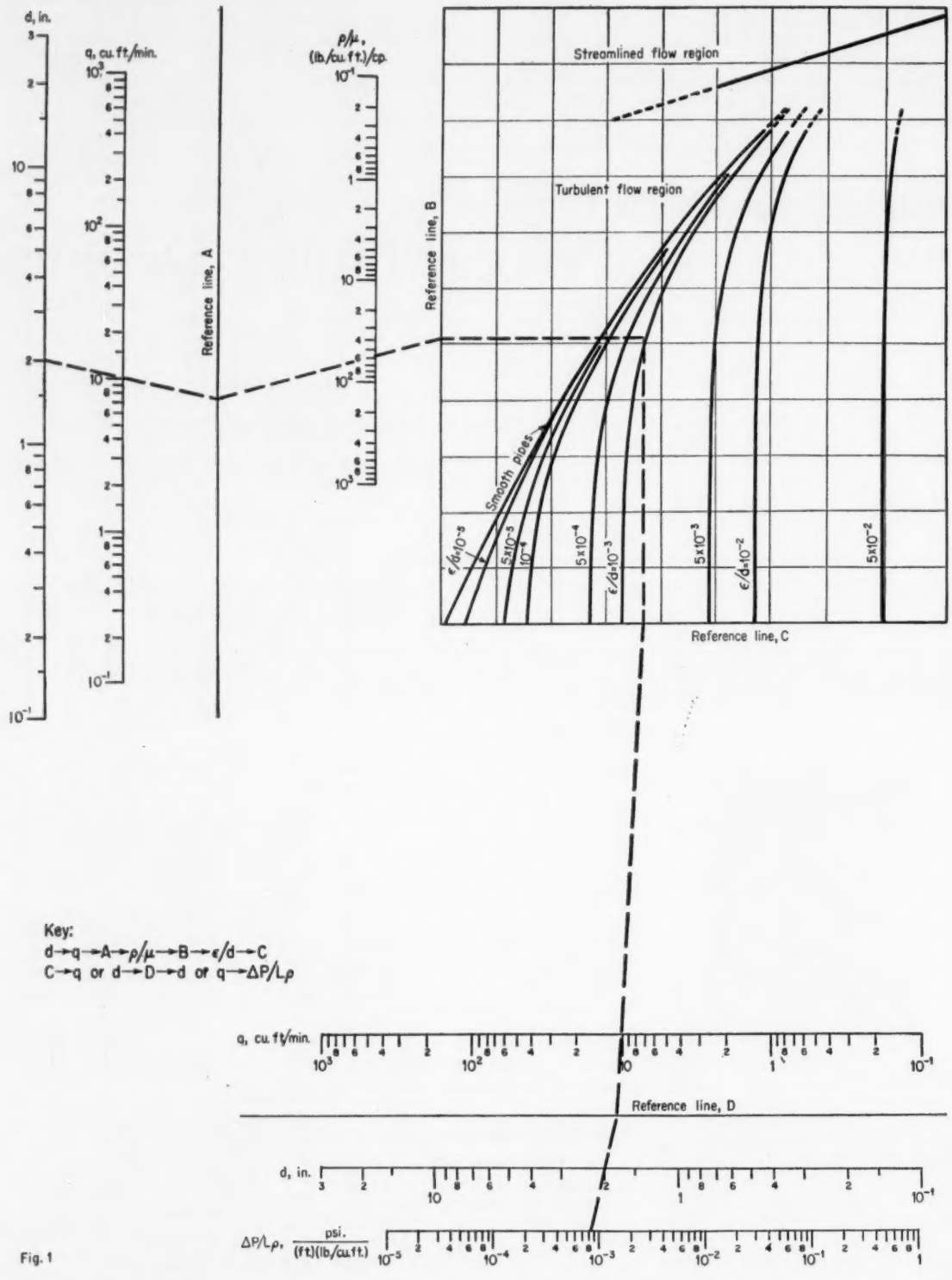


Fig. 1

This Chart Approximates Flow Rate or Pipe Size if Either Is Unknown

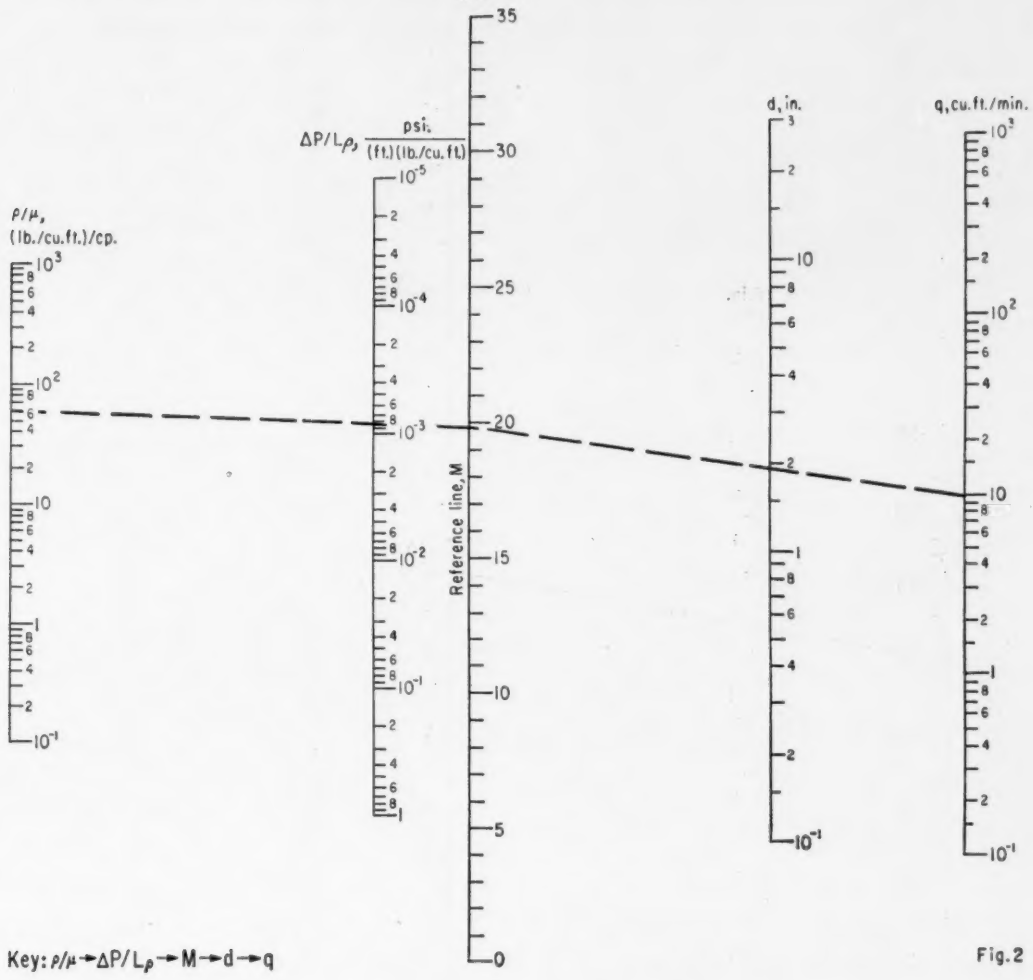


Fig. 2

basis of the nomograph in Fig. 2; the equation is: $f = 0.2\ N_{Re}^{-0.2}$. Fig. 2 solves the equation:

$$\frac{q^{1.8}}{d^{4.8}} = 1{,}357\left(\frac{\Delta P}{L\rho}\right)\left(\frac{\rho}{\mu}\right)^{0.2}$$

Finally, the nomograph in Fig. 3 solves this equation:

$$q = 0.327\ d^2\ V$$

All three nomographs were constructed by using a simple and familiar engineering method.[2, 3]

Simple and Easy to Use

A. Find Pressure Drop—All calculations on Fig. 1 begin with the vertical q and d scales. Calculate ϵ/d from values of ϵ in the table and d. Connect q with d to Line A; then Line A with ρ/μ to Line B.

Values of Pipe Roughness Factors, ϵ

Material	ϵ, In.
Glass, drawn brass, copper and lead —smooth	0
Drawn tubing	0.00006
Commercial steel or wrought iron	0.0018
Galvanized iron	0.006
Cast iron	0.0102
Wood stave	0.0072–0.036
Concrete	0.012–0.12
Riveted steel	0.036–0.36

Proceed across from Line B to the correct ϵ/d curve; then go vertically to Line C. Connect Line C with either q or d to Line D; then, Line D with either d or q (the one not used in the last step), and read $\Delta P/L\rho$.

B. Find Pipe Size or Flow Rate—This calls for trial-and-error work. On Fig. 2, connect ρ/μ and $\Delta P/L\rho$ to Line M; then connect Line M with either d or q (whichever is known), and read the first approximation to q or d (the unknown).

Now, use Fig. 1 as described in Method A, solving for either q or d instead of $\Delta P/L\rho$. If the calculated unknown variable on Fig. 1 is not

Knowing Flow Velocity, Find Flow Rate and Pipe Size

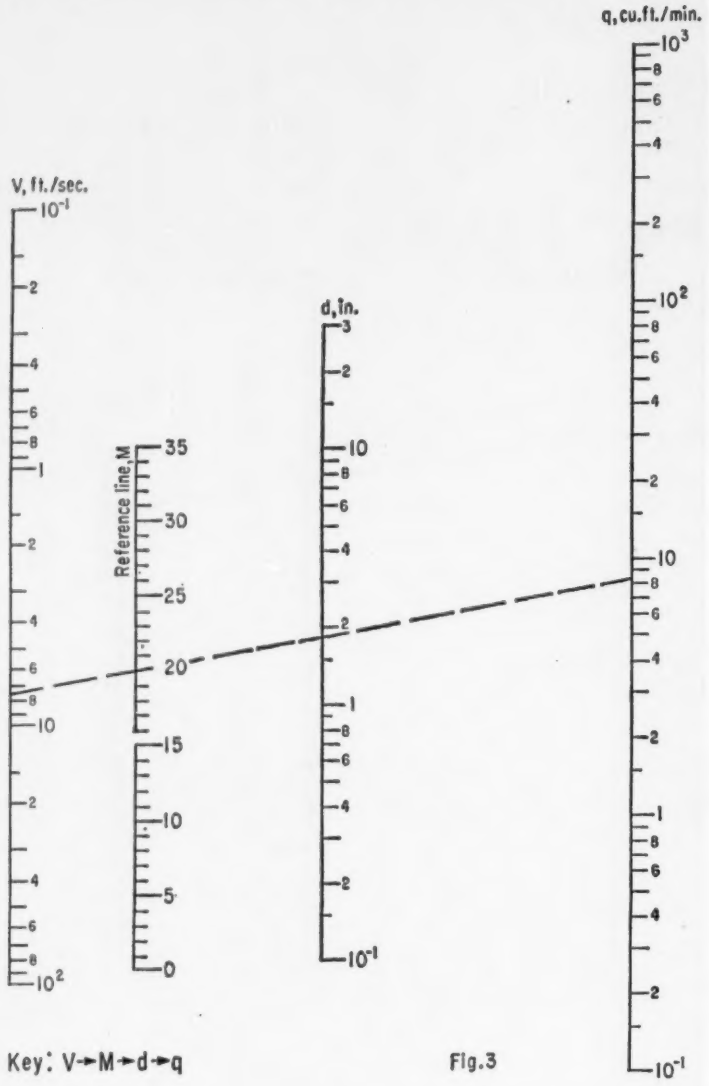


Fig. 3

the same as the first approximate value, repeat the calculations on Fig. 1 using the just-calculated answer as the next starting value for the unknown q or d. Repeat the cycle on Fig. 1 until the answer and the beginning value of the unknown are equal.

C. Find Pipe Size When Velocity, Not Flow Rate, Is Known—Connect ρ/μ with $\Delta P/L\rho$ on Fig. 2 and read value on Line M. Connect this value on Line M in Fig. 3 with V, and read approximate d and q values. Then go to Fig. 1 and follow Method A, solving for d as the unknown answer.

Connect this calculated value of d from Fig. 1 with V on Fig. 3 and read a corrected q value on Fig. 3. Repeat Method A, going back to Fig. 3 when needed, until the assumed and calculated values of the unknown agree on Fig. 1.

Try One for Practice

For: $d = 2$ in.; $q = 10$ cu. ft./min.; ($V = 7.64$ ft./sec.); $\rho = 60$ lb./cu. ft.; $\mu = 1.0$ centipoise; $\epsilon = 0.0018$ in. (commercial steel); and $L = 100$ ft., calculate ΔP.

Then, assume d is the only unknown and solve for it; similarly, solve for q if it's the only unknown. Finally, find d when V, but not q, is known.

Find ΔP—On Fig. 1, connect $d = 2$ and $q = 10$ with Line A. From point on Line A, connect $\rho/\mu = 60$, and mark point on Line B. Proceed horizontally on graph to $\epsilon/d = 0.0009$, then vertically to Line C. Connect this point on Line C with either $q = 10$ or $d = 2$ and Line D. Finally, connect point on Line D with d or q (whichever was *not* used in the last step) and read $\Delta P/L\rho = 8.26 \times 10^{-4}$. Then, $\Delta P = 8.26 \times 10^{-4} \times 100 \times 60 = 4.96$ psi.

Find d or q, When One Is Known: On Fig. 2, connect $\rho/\mu = 60$ and $\Delta P/L\rho = 8.26 \times 10^{-4}$ with Line M. With point on Line M, connect $q = 10$, and read approximate answer $d = 1.9$ in.

Going to Fig. 1, connect $d = 1.9$ and $q = 10$, and proceed as in Method A, using $\epsilon/d = (0.0018/1.9) = 0.000946$, and read the second answer as $d = 2.0$ in. Repeat calculation until d becomes constant. The same steps are used if q is to be found.

Find d or q, Knowing Only V—On Fig. 2, connect $\rho/\mu = 60$ with $\Delta P/L\rho = 8.26 \times 10^{-4}$ and read $M = 19.9$ on Line M. Then, on Fig. 3, connect $V = 7.64$ and $M = 19.9$; read $d = 1.8$ and $q = 8.2$. Now, proceed as in Method A, solving for d on Fig. 1. Connect the calculated d with $V = 7.64$ in Fig. 3, and read a new q value. Repeat Step A on Fig. 1. You may have to work back and forth on Figs. 1 and 3 until the values of d and q are the same on each nomograph.

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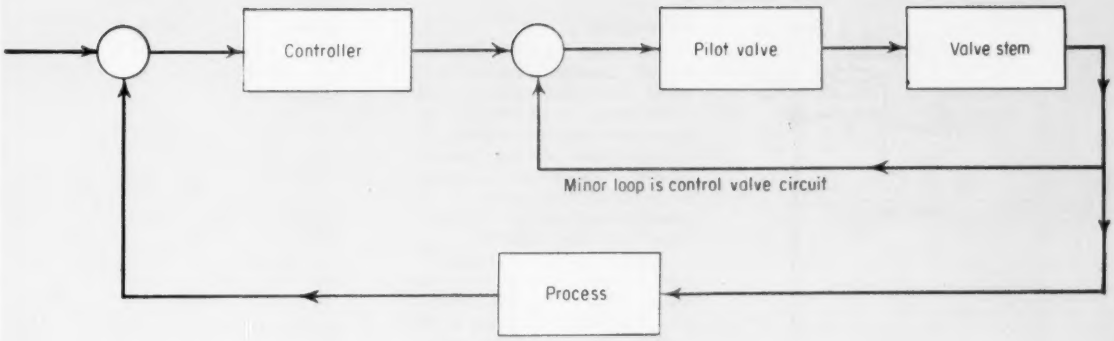


For high thrust forces on valve plugs . . .

Use Control Valve Positioners

Pneumatic or hydraulic operators in response to controller signal changes increase speed of control valve action by providing larger forces on valve stem.

WERNER G. HOLZBOCK, GPE Controls, Inc., Chicago, Ill.*

VALVE positioners are devices which amplify controller signals. They provide large forces with which to operate control valves when nonlinear forces predominate.

Valve positioners are advisable whenever one or several of the following conditions prevail: coking of valve trim, tight packing, high fluid velocities through single-seated valves, split-range valves, controller signal changes by 0.2 psi or less, and adjustment of ratio between controller signal and valve-stem travel is necessary.

In this fifth and concluding article on control valves, we'll cover these factors as well as the types of valve positioners, their methods of operation and their limitations.

Ordinary diaphragm-and-spring control valves are load sensitive. In load-sensitive valves, air pressure on top of the diaphragm, force of the valve spring, and thrust forces across the valve plug determine the position of the valve plug. Since the thrust forces which depend on valve opening and flow velocity change, a fixed relationship is not possible between air-pressure signal and valve position.

Furthermore, friction caused by the packing in the stuffing box, may prevent the control valve from moving in response to a small increment in the controller output signal. Hence, a dead-band results and performance of the control system may deteriorate considerably.

Valve positioners eliminate most of the shortcomings caused by

*To meet your author, see *Chem. Eng.*, March 9, 1959, p. 140.

Position-Balanced Valve Operators

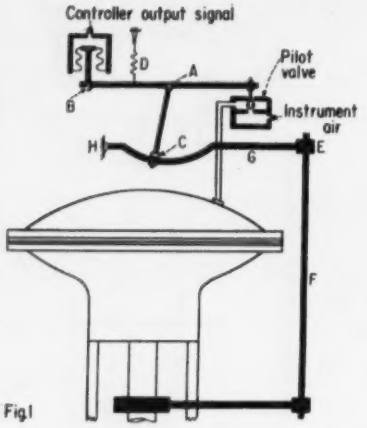


Fig.1

Principle

Controller signal transmitted through bellows and lever changes position of pilot valve which admits instrument air to diaphragm or exhausts air to atmosphere. Valve-stem motion feeds back through rod *F*, lever *G* and link at *C* to balance controller signal.

Adjustment on lever at *C* and feedback lever *G* controls valve stroke. Floating pivots are *A* and *B*, fixed pivot is *H*. Spring *D* repositions pilot valve, point *E* is contact between rod *F* and lever *G*.

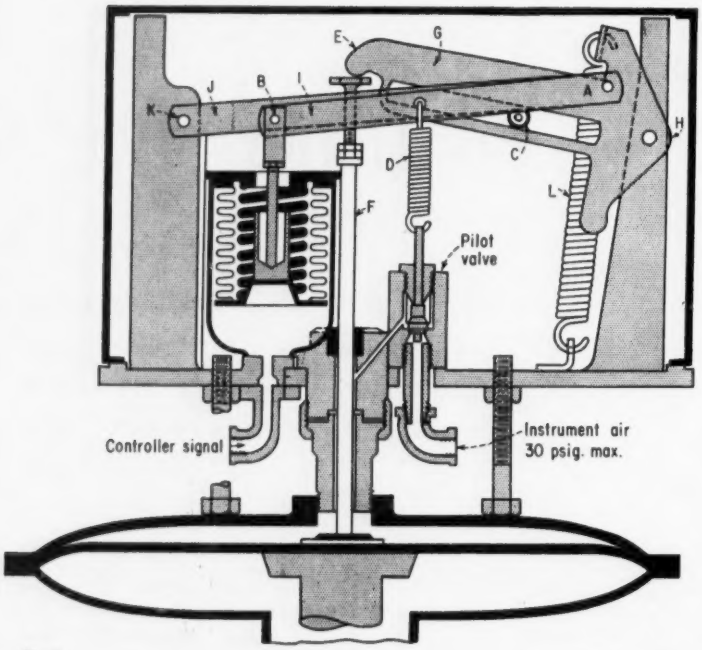


Fig. 2

Minneapolis-Honeywell

Application

In an actual position-balanced operator, controller signal acts against a spring-loaded bellows. Letters in Fig. 2 illustrate operator movements which correspond to functions described by same letters in Fig. 1. However, feedback of valve-stem position rotates lever *G* about pivot *H*. This action raises lever *J* which rests on pivot *C* and repositions pilot valve through spring *D*.

spring force, balancing signal and thrust in the diaphragm-and-spring valve. A valve positioner continuously compares the position of the valve stem to the controller output signal. In most cases, the positioner is an auxiliary device attached to the conventional diaphragm-and-spring valve.

How Positioners Work

In Fig. 1, the schematic drawing shows the principle of position-balanced valve positioners. The spring-opposed bellows maintains a position which is proportional to the controller output signal. A lever connected to the bellows operates a pilot valve which admits instrument air to the valve diaphragm. As the valve stem moves, valve position is fed back to the bellows through a lever which turns about point *B*. This feedback motion repositions the pilot valve to a point where the control valve no longer moves. The valve then assumes a new position, proportional to controller signal.

Lever *C* adjusts to change the proportion which *A* moves with respect to the valve motion. This changes the amount of feedback and determines valve stroke per unit change of controller output signal.

Fig. 2 shows an actual valve positioner which operates on the position-balance principle. A regulated air supply provides instrument air at 30 psig. maximum. Controller output signal pushes against a spring-loaded bellows. The spring reduces the nonlinear and hysteresis characteristics of the bellows to a minimum. Hence, bellows movement is proportional to the controller output signal.

Bellows movement is transmitted to the left-hand end of lever *I* which rotates about a free-floating pivot at *A*. Also, at point *A*, levers *I* and *J* come together. Lever *J* rests on pin at *C*.

Movement of lever *I* raises or lowers stem of pilot valve. The stem of the pilot valve is pulled downward by a spring in the pilot valve and upward by spring *D*. For example, as spring *D* relaxes, valve stem moves downward to uncover a bleed valve. Air escapes from the valve diaphragm to the atmosphere through the interspace between rod *F* and the bushing. Conversely, if pilot valve stem moves up, inlet port opens to admit air to the valve diaphragm.

The resulting motion of the valve diaphragm is transmitted through rod *F* to rotate lever *G*. This lever is kept in contact with rod *F* over the adjusting screw by means of spring *L*. Lever *G* rotates about its pivot at *H*. As lever *G* rotates, it moves pin *C*. Hence, lever *J* rotates around its pivot at *K* and, in turn, raises or lowers pivot point *A*. Rotation of lever *I* about pivot *B* repositions the pilot valve through spring *D*.

For example, let the controller output pressure increase. Point *B* moves upward and the pilot valve admits air to the valve diaphragm. Rod *F* moves downward with the diaphragm and lever *G* rotates counterclockwise. This action lowers pin *C* and, hence, pivot *A*. The pilot valve starts closing until the spring and thrust forces balance, and the control valve stem stands still. Thus, a precise change in position occurs for any given change in controller output signal.

To adjust valve stroke, pivot *C* can be moved in the slot to change the amount of feedback. Moving this pivot to the left decreases motion of lever *G*. Hence, the stroke for a given change in controller signal is shortened. The adjustment screw, located at the top of rod *F*, provides a certain valve position for a given controller signal, or any desired set point.

Fig. 3 is a diagram of a force-balanced valve positioner. The controller output signal, acting through the bellows, displaces the lever against the force of the feedback spring.

For example, an increase in controller output signal moves the lever and opens the pilot valve to admit instrument air to the top of the diaphragm. In response to increased air, valve stem moves downward. This action stretches the feedback spring, increasing its force, and returns the pilot valve to its initial position. At this point the valve stem settles in its new position.

Stroke adjustment follows the principle of the position-balanced valve positioner. Feedback ratio changes by adjusting the lever ratio.

Fig. 4 shows an actual force-balanced positioner. Instrument air is admitted through a bypass valve to the pilot valve. Supply and exhaust valves, as parts of the pilot valve, are shown in the illustration.

Force-Balanced Valve Operators

Principle

Controller output signal displaces lever which positions pilot valve. In response to controller signal, pilot valve exhausts air to atmosphere or admits instrument air to top of diaphragm.

Control valve feedback rod repositions pilot valve through feedback spring to achieve balance with incoming signal. Changing lever ratio of valve stroke adjustment varies feedback ratio. Feedback levers have fixed pivots at *A* and *B*.

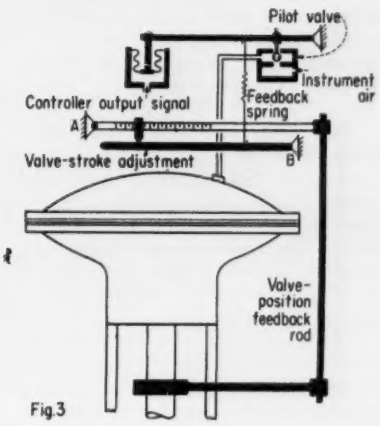


Fig. 3

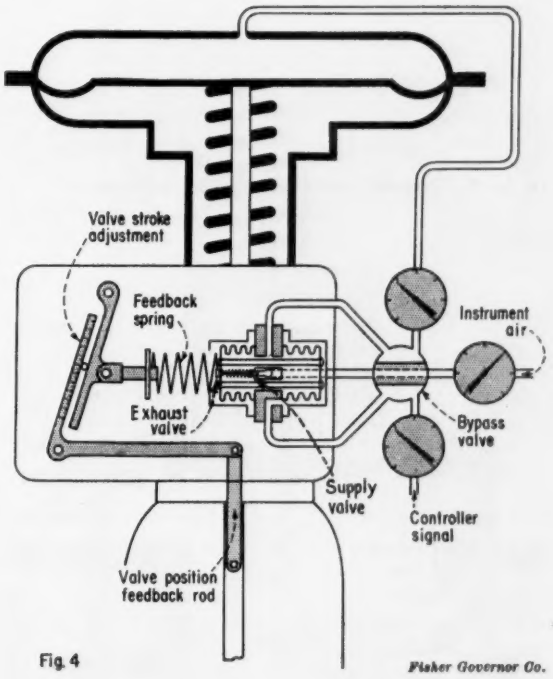


Fig. 4 *Fisher Governor Co.*

Application

Bellows assembly moves in response to controller signal to uncover exhaust or supply valves in pilot. Feedback of valve stem position occurs through crank and feedback spring. Feedback spring connects feedback levers to bellows and balances valve stroke against controller signal. Bypass allows controller signals to act directly on valve diaphragm for easy maintenance of controller.

Valves open or close by movement of the bellows assembly.

Two bellows mounted on opposite sides of the valve block operate the pilot. These bellows are connected to each other by push rods which go through openings in the valve block.

The right-hand bellows is covered and sealed by a cup to which the controller output pressure is admitted. This pressure tends to push the bellows assembly toward the left. The feedback spring pushes against the left-hand bellows to oppose the action of the controller output pressure.

If the controller output pressure decreases, the bellows assembly moves to the right. This opens the exhaust valve. Hence, air from the control valve diaphragm exhausts to atmosphere. The resulting decrease in diaphragm pressure moves the valve stem upward and rotates the feedback lever about its pivot. This motion is followed by other lever rotating about its pivot. The two levers are kept in contact with each other by the force of the feedback spring.

Relaxation of the feedback spring moves the bellows assembly toward the left and closes the exhaust valve. Then valve stem stops in a position which is proportional to the controller output signal.

A bypass valve may connect the control valve diaphragm directly to the controller output signal. Hence, the valve positioner may be removed for maintenance without interrupting the process.

Moving the valve-travel adjusting screw changes control valve stroke. Changing the lever ratio changes the amount of feedback.

Limitations of Positioners

Instrument air fills the space above the diaphragm in air operated diaphragm-and-spring valves. Valve positioners reduce the volume of air which must otherwise be transmitted from the controller. Within certain limitations, these positioners give faster response of the control valve.

If the controller signal varies from 3 to 15 psi., a valve positioner will not increase the response speed of a valve unless the instrument air supply is more than 15 psi. This condition occurs because the pilot valve port-area in the controller as well as in the positioner are of the same order of magnitude. However, for minor changes of controller output signal, amplification of this signal by the valve positioner produces faster response than can otherwise be obtained.

The extent to which the valve positioner accelerates valve motion depends on certain gain characteristics. For example, if a 3-psi. change in the controller output signal is converted into 12 psi., the gain factor is four. However, this gain does not affect the control loop as such.

As shown in the diagram on p. 107, the control valve and the valve positioner represent a minor loop within the major control loop. This minor loop contains the controller output signal, the action of the pilot valve, the valve stem motion, and the feedback to the controller output signal. The major control loop reflects only the change in port opening of the control valve and not the method which produces this change.

Pressure of the air supply limits the gain of a valve positioner. A typical valve positioner may require a change of 0.07 psi. in the controller output signal to move the pilot valve from fully closed to fully open. If the control valve is closed at 3 psi. and the instrument air supply is 15 psi., an increase of the controller output signal from 3 to 3.07 psi. produces an initial pressure drop of 12 psi. across the pilot valve. Initially, the diaphragm receives a high rate of air flow which gradually decreases to correspond with the new valve position.

Suppose the valve carries, at a given position, 14 psi. air pressure on the diaphragm. A change in controller output signal of 0.07 psi. will now result in an initial pressure drop of 1 psi. across the pilot valve. Hence, valve motion is correspondingly slower.

How to Get Proportional-Position Action

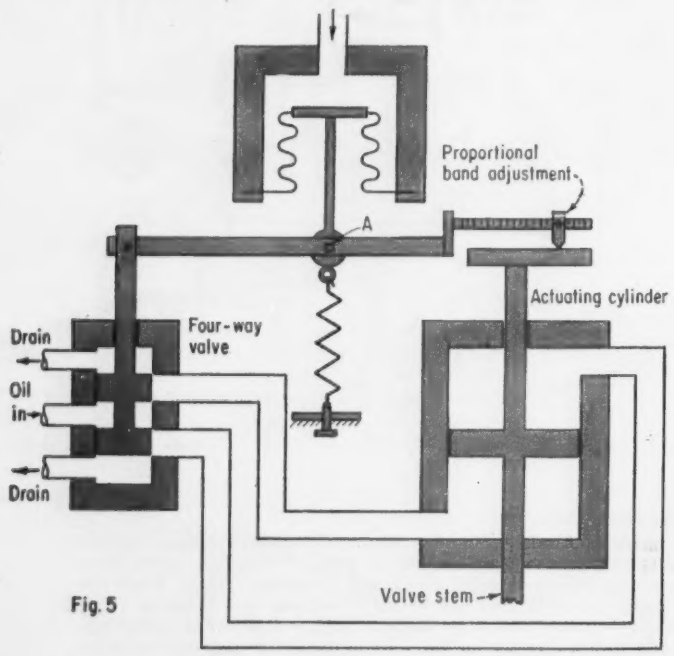


Fig. 5

The main advantage of increased gain and its resultant additional force is to reduce the detrimental effects of friction and thrust. However, the positioner does not necessarily offer this increased gain under all conditions. Even where increased gain is available, it is still possible for fast changes in thrust to change the valve position. Time lags in the feedback and pneumatic circuits are responsible for this change in position.

In general, these valve position changes are not harmful, or at least less harmful than the pressure changes in the process fluid which produce the variations in thrust. Accurate control can hardly be obtained where sudden pressure changes occur in the process fluid. Erratic valve-stem position may be the visible expression of a more basic trouble in the control system.

When Are Positioners Needed?

Valve positioners are necessary when the positioning of the valve is opposed by nonlinear forces of more than negligible magnitude. Specifically, the following conditions make the use of positioners advisable:

1. Service which causes coking of valve trim. Coking means the deposit from the fluid and the accumulation on valve trim of residues which pack together and harden. However, coking can be so strong that a valve positioner is no longer a remedy. The problem must be solved by either providing valves with suitable configuration, or by examining the situation in the fluid. Maintaining the valve at a higher temperature by steam coils or electrical heaters is sometimes an efficient remedy.

2. If character of the fluid passing through the valve requires more than normal tightening of packing glands. Frequently Teflon packing remedies this condition; or where this packing is not applicable, a bellows seal may be chosen.

3. Single-seated valves at high fluid velocities.

4. Split-range valves. This means that one valve moves from open to close with a change in controller output signal from 3 to 9 psi.; and another valve operates with a change in signal from 9 to 15 psi. Both valves are connected to the same controller output signal.

5. Valves which are expected to respond to a change of 0.2 psi. or less in controller output signal.

6. Adjustment of ratio between air signal from controller to movement of stem. Generally, the adjustment is determined by the proportional band of the controller action. Where the band is not adjustable, a valve positioner is suitable.

Convert Electrical Signal Into Mechanical Motion

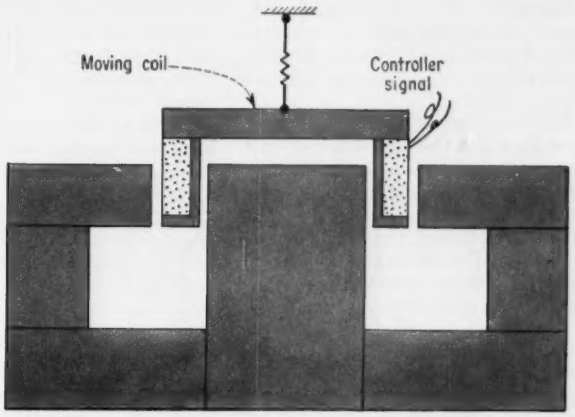


Fig. 6

Self-Contained Power Source Actuates This Positioner

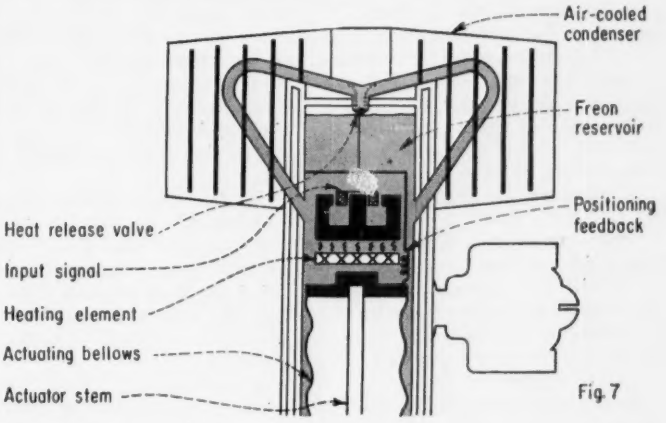


Fig. 7

Hydraulic Positioning

Hydraulic positioning has the advantage, compared with pneumatic, in that high pressures can be more economically produced. Hydraulic positioning is advantageous where equipment and power consumption are comparatively small.

A pneumatic power supply requires compressors, pressure reducing valves, storage tanks, aftercoolers, etc. Transmission of high pressure air over long distances causes considerable pressure drop. On the other hand, hydraulic pressure generation requires no more than a pump and an electric motor

to drive it, a storage tank for the oil, and a pressure relief valve. Small units are available for installation next to the point of application. Pressures of 100 to 400 psi. are common and, occasionally, go as high as 3,000 psi.

Fig. 5 shows a typical arrangement in which the pneumatic output positions a four-way valve. If a diaphragm-and-spring operator is used, the spring underneath the diaphragm causes the spool of the four-way valve to assume a position which is proportional to the magnitude of the controller output signal.

When the signal increases, the spool moves downward. Hence, a connection is established between the upper part of the actuating cylinder and the oil supply, and between the lower part and the drain. As long as the spool is in the center position, hydraulic fluid is locked on either side of the actuating piston. Therefore, the piston cannot move in either direction.

In the absence of a feedback arrangement, large displacements of the pilot valve cause faster response of the actuating piston. The motion continues as long as the controller output signal persists or until the piston reaches the end of its travel. Hence, this arrangement gives proportional-speed floating action.

Where proportional-position action is desired, feedback of the piston position is necessary. Fig. 5 illustrates an arrangement which provides this feedback. In this case, the controller output signal is connected to a bellows.

Suppose the signal increases. The increased signal compresses the bellows and rotates the crossarm about the pivot. The spool of the four-way valve moves downward to connect the oil supply to the top of the actuating piston and to provide a drain from the bottom.

The piston now moves downward. Since the crossarm is kept in contact with the piston position by the spring, the crossarm rotates about pivot A and moves the spool of the four-way valve upward. At the moment where the spool again covers the two ports connecting to the actuating cylinder, the piston is locked. It stays in this position until another change in controller output signal calls for a new piston position. This arrangement assures that the piston position is at all times proportional to the controller output signal.

A stroke adjustment allows shifting movable pivot with reference to pivot A and hence, changes the magnitude of feedback. Moving pivot to the left gives a lever ratio which requires less stroke of the actuating piston to return the spool of the four-way valve to the closing position.

Electric Signal Conversion

Progress in electronic control systems has produced the problem of a suitable conversion of the signal from the electronic controller to a valve position.

One method converts the electric signal into a pneumatic air pressure and applies this signal to a conventional diaphragm-and-spring valve. The converting unit may either be an electropneumatic relay or an electropneumatic valve positioner. The latter is similar to the previously described valve positioner, except that the input signal is electric.

Another method provides an electrohydraulic unit which is, generally, equipped with a self-contained hydraulic pump-and-motor unit. A third method, recently introduced, has a self-contained unit which maintains a liquid at boiling temperature.

Practically all these conversion units utilize a moving coil to produce mechanical motion from the electrical input signal. The principle of the moving coil is shown in Fig. 6. A magnetic field is produced by a permanent magnet. A coil of wire wound on a bobbin moves in the air gap provided by the magnetic structure. The force of attraction or repulsion depends on the direction of current flowing through the wire relative to the magnetic field. The following equation expresses this relation:

$$F = 9 \times 10^{-8} BLi$$

where F is force, oz.; B is magnetic flux density in the air gap, gauss; L is length of wire in coil, in.; and i is the current, ma.

Unfortunately, the forces, thus produced, are comparatively small. With reasonable magnet izes, the maximum force from a 5 ma. signal is about 10 oz. This value compares with 15 lb., or 24 times as much, that can be obtained from a 15-psi. signal on a diaphragm area of only one square inch. Moreover, the force can easily be multiplied by increasing the diaphragm area.

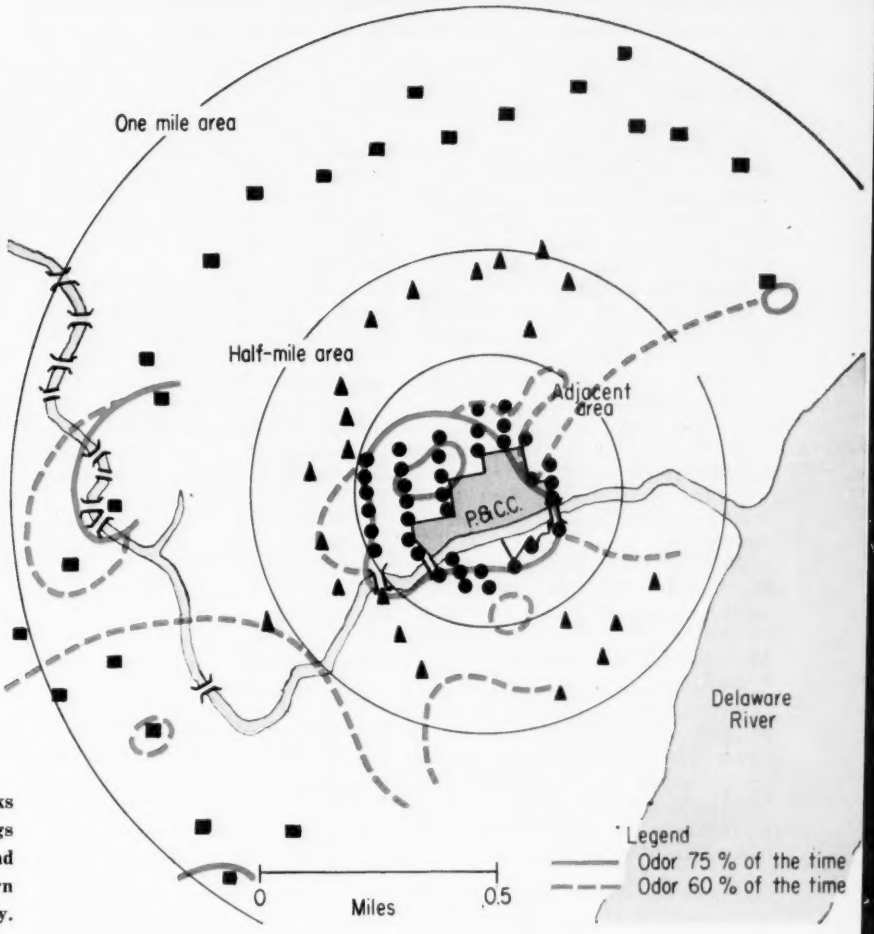
New electronic controllers increase the magnitude of signals by using 4 to 20 ma. or 10 to 50 ma. instead of 1 to 5 ma. However, if the higher signal is accompanied by a decrease in maximum load resistance, the length L in the above equation has to be reduced. The net result may be that the available force remains the same.

Typical examples of an electropneumatic relay and an electrohydraulic actuator have been described in a previous article* and need no further reference here.

However, the Swartwout Co. has come out with a novel actuator whose principle is shown in Fig. 7. An electric heating element vaporizes the Freon compound in which all parts are immersed. The input signal enters the moving coil which regulates the heat release valve. Vapor passes through this valve into the condenser. In the condenser, the vapor liquefies and flows back to the container. Vapor pressure of the Freon varies with the opening in the heat release valve. A larger opening of the valve increases rate of liquefaction and, hence, vapor pressure decreases.

When the moving coil decreases the opening of the heat release valve, the vapor pressure increases and exerts a downward force on the actuating bellows. This moves the actuator stem downward. The spring in the feedback linkage exerts an increasing pull as the stem moves and gradually opens the heat release valve. Hence, the vapor pressure of the Freon decreases until the motion of the stem stops.

*W. G. Holzbock, "Controllers and Final Control Elements," *Chem. Eng.*, June 1957, p. 259.



Map of Allied's Frankford Works and surroundings shows sampling points and odor frequency pattern as found by an odor survey.

How to Make an Odor Survey

A. N. HELLER, H. J. KANDINER, W. M. REITER and M. COHEN

ODORS often represent the only contact between a chemical processing plant and its neighbors. Though it's comparatively easy to locate the sources of and to define the quantities of discharges such as dust and smoke, odor-source detection and quantitative evaluation of its potential nuisance level may be quite difficult. This problem gets more complicated because often not one odor, but the combined effect of several odors, causes discomfort and complaints. Finally, plant personnel often become relatively immune to process odors and are not aware of any problem at all.

Since the basis for odor complaints rests on subjective responses by neighbors or by local regulatory authorities, the only method for a plant to evaluate effectively its contribution to the odor pattern of an area is by an odor survey. Such a survey provides the plant with a sampling of odors to which neighbors are exposed, assistance in locating odor sources, a measure of its contribution to the area odor pattern, a control by which plant supervision can be alerted to take corrective action, information leading to process improvements and improved community relations.

Extensive odor surveys were carried out in 1954-55 in the area of Allied's Frankford Works (Philadelphia, Pa.)—one of the world's largest coal-tar chemical plants. The principal purpose of such surveys is to provide an objective and more reliable yardstick than neighborhood complaints for immediate and long-term planning in odor control as part of air pollution control. Here are procedures for an odor survey, based on ours at Frankford Works.

Classification of Odors—In a survey, try to identify odors from spe-

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cific substances or plant operating areas, rather than to characterize them on the basis of odor sensation. We believe this type of identification is easier to use and more significant in terms of results than other proposed systems.[1, 2, 3]

All individual odors observed were grouped into three primary categories at Philadelphia:

- Non-industrial—sewage, motor fumes, cooking, etc.
- Industrial, probably Frankford Works—tar acids, phthalic anhydride, formaldehyde, etc.
- Industrial, not Frankford Works — rendering, chocolate, amines, etc.

We have set up a numerical coding scale for odor intensity similar to the one subsequently described by others.[5, 6, 7] The strongest odors have the highest numbers in this system:

Intensity	Definition
0	No odor
1	Mild, weak or faint odor —barely detectable
2	Distinct odor
3	Strong odor
4	Irritant odor — eye, throat or skin sensitivity
5	Intolerable odor

Personnel—When selecting field personnel for an odor survey, you should regard conscientiousness as more important than exceptional odor sensitivity; in fact, at Frankford, we did not make a test for the latter, since we wished to simulate the probable response of normal people to our odor pattern. Most of our personnel came from other Allied plants, or were specifically hired for this assignment, because we found that operating people at Frankford Works were relatively insensitive to odors associated with plant operations, possibly because of sense-of-smell fatigue.[6]

To acquaint survey personnel with various odors in the area—from your plant and other close-by sources—give the surveyors a brief orientation and training course. During this course, conduct the men through your plant and its neighborhood to "educate" noses over a period of several days. Small reference samples of raw, intermediate and finished materials from your own plant should be available to facilitate sharper identifications of plant odors.

In Philadelphia, our observers were well received in the area under study because we had taken time to make efforts to acquaint neighborhood-community leaders with our purpose. Splendid cooperation was received from the police, particularly during late evening inspections.

Survey Area — At Frankford Works, the survey area covered as far as one mile from the plant in order to evaluate the effect of odors from non-Frankford Works sources. The presence or absence of odor was determined at a number of selected sampling points on specified survey routes in the area, as shown on the map. Local meteorological or other factors may require a different area-size for your odor survey.

Routes we used were adjacent to the plant perimeter, ½ mi. and 1 mi. distant, respectively. The adjacent route was traversed on foot, while motor transportation was used to reach locations on distant routes. Even though he drove an automobile to the spot, the inspector got out of the car and made his observations while walking around the sampling location.

Initially, observations were continued on a 24-hr., 7 day/week basis, but coverage was later reduced to a single shift, 2-10 P.M. when we found that this period produced the highest complaint frequency.

Interpretation of Data—Record survey data on a report sheet, using one sheet for each survey trip. Data written down should include: point location, route, time, odor type and intensity, and local meteorological data such as wind and temperature. At Frankford, 4-6 trips were made during each working shift.

Examine raw-data sheets when received to give plant operating and technical personnel a picture of which odors are the most severe and might cause complaints. By establishing which odors are detected most frequently—especially along the adjacent route—the contributing processes can be identified and studies initiated promptly to develop controls for those sources. Report sheets also can be used to confirm the correctness of any complaints received during the survey time.

Transfer observations from report sheets to tally sheets, where all odors are classified by type and intensity for all sampling locations and plotted on a map of the area. Smoothed curves termed "iso-frequency" or "iso-contributions" can then be drawn.[4] Iso-frequency lines represent lines along which odors were observed at a given frequency (based on total number of observations); iso-contribution lines represent lines along which specific odors are a given percentage of the total odors encountered.

Thus, a graphical representation is obtained which indicates the general area odor pattern as well as the degree to which your plant contributed to that pattern. Drawn on the map on the preceding page are results for iso-frequency lines of number 1 odors around Frankford Works.

After we analyzed the distribution of odors from Frankford with distance from the plant, it became evident that the adjacent area would serve satisfactorily as an observation post. Periodic surveys in this area can be a basis for routine odor control. Random checks of the outlying area would, of course, be desirable. One positive result of our own survey has been a sharp reduction in the number of air pollution complaints attributed to Frankford operations (from 67 in 1954 to 13 in 1958).

As an improvement, we suggest that, in addition to the technique presented above, your odor survey be designed to include randomization of observations and a more uniform distribution of sampling points around the plant and in the study-area. To facilitate data collation, information obtained should be placed on punched-cards.

This article is based on a paper we gave at the Manufacturing Chemists Association Meeting's Air and Water Pollution Abatement Conference in Cincinnati on Mar. 18-19, 1959.

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Recent progress on three fronts puts PVC piping in the news today . . .

PVC Pressure Piping Comes of Age

- Properties of the plastic have been improved.
- Better cements are making better joints.
- New standards link producers and molders.

F. J. STAUDT, E. I du Pont de Nemours & Co., Wilmington, Del.

IT IS normal for all new products to go through a period of trials, successes and failures. Pressure piping systems of polyvinyl chloride (PVC) are no exception. Let's take a better look at some of this product's growing pains, and how the thermoplastic industry cured them.

Certain conditions existed that normally would have prolonged the testing or experimental period for PVC pressure piping systems. We refer primarily to the fact that pipe, fittings and cements are, for the most part, manufactured by different organizations.

In a new industry without national standards, it was difficult for these various organizations to coordinate efforts. Fortunately for the industry, this initial period is past, and installation of PVC piping systems is now common practice.

This does not mean that we have reached the end of development, however. Improved methods of quality control, better inspection, refined techniques of extrusion and molding, increased size range of all elements, and reduced costs are current and ever-present goals.

Practical Piping Assembly

There are two schools of thought with respect to piping assembly. One school relies on interference between the pipe and the socket; here, thin unfilled solvent cements soften the mating surfaces during assembly. For pipe sizes 2 in. and above, however, impractically large forces are required to bottom the pipe in the socket, even with cement properly applied.

The other school promotes an assembly method that permits essentially no interference between socket and pipe, and that depends on a filled solvent cement to close the diametral gap between the pipe and socket—this gap may be as much as 0.040 in.

With such a method, an intricate piping system may be completely assembled and bottomed in the dry state. After all parts of the system are fitted and cut to size, the construction crew dismantles the setup, applies cement to each component, and permanently reassembles the system. Dry assembly is impossible with interference joints and unfilled cements.

We will limit the remaining content of this article to discussion about the pipe, fittings and cement appropriate to noninterference, filled-cement piping systems.

Upgraded Chemical Resistance

Going back over the years, we find that PVC molding compounds have generally been of good quality, as they contain little or no polymeric materials other than PVC. Consequently, they have always had good chemical resistance and could be used for 93% sulfuric acid at 120 F.

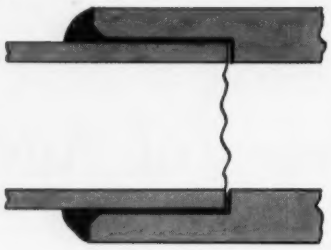
For pipe compounds, however, good chemical resistance has not always been the rule. The art of extrusion wasn't originally well developed, and in order to obtain a good-looking product with relatively good chemical and mechanical properties, certain polymeric materials were added to the extruding compounds. These additives had very undesirable effects on chemical resistance. Several different vendors' products would deteriorate rapidly while handling 93% sulfuric acid outdoors.

In the last two years, a performance test has aided evaluation of the deleterious significance of polymeric additions to PVC compounds. A healthy search for better pipe compounds, involving much work by resin producers and pipe extruders, is now paying off.

At least six large pipe extruders now have, as a standard product, a highly resistant PVC pipe that is classified Type 1 Grade 1 in a tentative ASTM specification. These companies are using at least four different sources for their resin compounds; all are suitable for use with 93% sulfuric acid outdoors.

Type 1 Grade 1 PVC compounds are generally more difficult to extrude; temperature control and extrusion speeds are more critical. It is only recently that the resin compounders and the pipe extruders have been able to solve the problem of making and extruding these more-resistant materials into pipe with close dimensional control. Facts such as these should indicate that, generally speaking, the whole industry has made good progress in upgrading the final product.

PVC pipe (Type 1 Grade 1) is currently available in sizes ½ through 6 in., with sufficiently good dimensional tolerances to make



practical the use of molded socket fittings and filled solvent cements. ASTM D-20 is almost ready to issue a specification on these sizes.

Progress in Socket Fittings

A second consideration in the development of today's PVC pressure piping systems was fabrication of an assortment of fitting shapes—90° and 45° ells, tees, flanges, caps, plugs, etc. Schedule 80 fittings are the most common. Recently, however, some Schedule 40 fittings have been made available, but these are used in some relatively few low-temperature and low-pressure services.

Schedule 80 fittings are sufficiently strong that Schedule 80 pipe will usually break first when made-up sections are hydrostatically tested. Also, the deep-socket Schedule 80 fittings assure adequate shear area, even though only 60% of available area might be cemented (and this happens with the best of crews). And, since PVC has such a large coefficient of thermal expansion, deep-socket Schedule 80 fittings are frequently subjected to recurring bending stresses that would be too great for shorter sockets or lighter fittings.

For several years, good-quality molded socket fittings have been available in sizes through 4 in. In the second quarter of 1958, a major supplier added the 6-in. size to his line. Molded 8-in. flanges were offered in the fourth quarter of 1958.

Fittings 2 in. and below have a molded tapered surface in the socket. Larger sizes are machined to a 0.015-in. total tolerance. Socket I.D. is a very important dimension because it must fit the pipe to within 0.040 in. to result in a high-efficiency joint.

Another important item is the "breaking" of the edge at the entrance to the socket. This is necessary in all sizes to preserve a good distribution of cement during insertion of the pipe; to aid in assembly—particularly when there is some misalignment; and in the larger sizes, to help shape the pipe to the socket if the pipe is out-of-round.

On smaller fittings, the break is usually made by rounding the edge. On larger fittings, a $\frac{1}{8}$-in. chamfer at an angle of 30° with the axis is most desirable.

All of these and other considerations of good design have now been incorporated in available quality fittings.

Good Filled Cements Available

Late in 1957, we began discouraging use of threaded systems and started relying almost solely on solvent-cemented joints. Solvent cements are composed of such things as tetrahydrofuran and methyl ethyl ketone with dissolved PVC solids.

After cement application, the solvents evaporate and leave the PVC to fill the gap. The cement shrinks during this evaporation. Consequently, there must be a good fillet of wet cement in position at the entrance of the socket while shrinking takes place. This is the only way to stop voids and shrink holes.

When using thin cements on 3-in. and larger horizontal lines, the assembly must be turned, or additional cement must be added at the top of the joint to assure an adequate fillet. Such procedures are unsatisfactory and costly.

During the last quarter of 1957, we started to test cements having inert fillers such as those used in thermosetting resins. We tried a flour of silica. In low concentrations, this filler gave good body to the cement, making it very slow to run, even in thick layers.

A satisfactory filled solvent cement is now available on the market. It is a significant improvement; one healthy brush application to the socket and pipe does the job. There is no longer any need to turn the assembly or to add more cement at intervals to maintain a well-filled joint.

Insertion of the pipe coated with filled solvent cement provides a large fillet that does not run off, but stays to supplant the solvent leaving the joint area. Using this cement, we have noted that fillets of well-made joints are convex immediately after insertion of the pipe, and concave 20 min. later.

Specifications Here Soon

There has been no mention of ASA or ASTM numbered specifications because none are currently available. However, the ASTM D-20 Committee on Plastics has a good PVC-compounds specification almost complete. It will provide for better understanding between PVC compound producers and the extruders and molders. It differentiates between PVC compounds that are good for 93% sulfuric acid and those that are not.

ASTM also has a new specification that sets, among other things, dimensions and tolerances for pipe through the 6-in. size. This has been a long, tough development, and it is close to issue date.

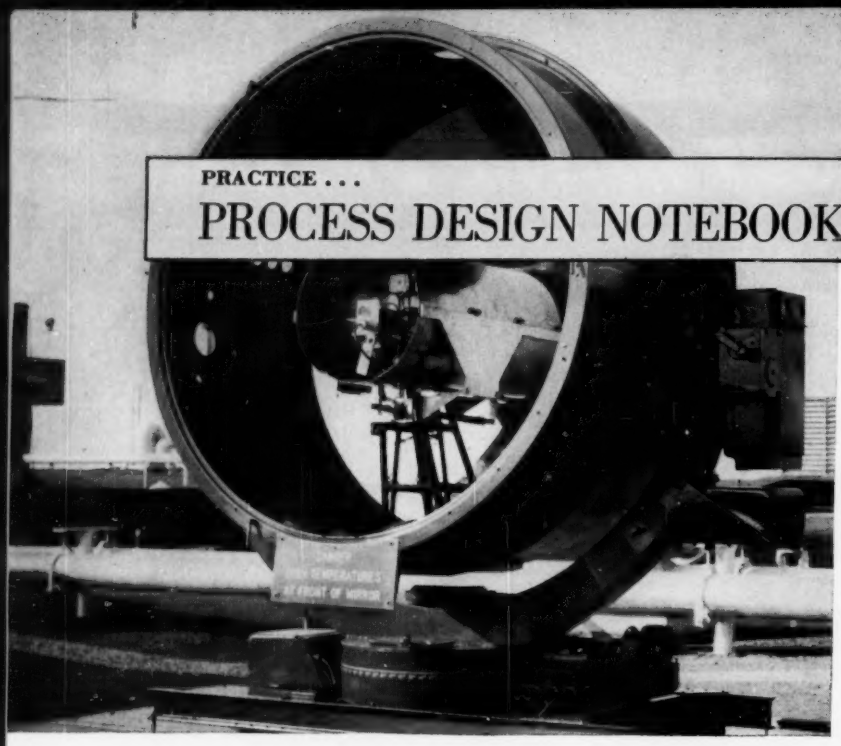
ASA B31.12 has submitted for committee ballot a draft of a standard for Schedule 80 PVC socket fittings. There will probably be some additions and changes before going to print, but it is well on the way to becoming a good standard.

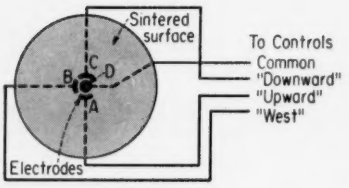
ASTM has a task force working on a specification for PVC solvent cement. The group met twice during 1958, and is well along the road to completion.

While these specifications are not yet available, products now offered by some extruders and molders are in accordance with the proposals. And you, as a potential user of PVC piping, can set up your own interim standards.

For example, Du Pont has five different specifications for PVC pressure piping systems. These set operating temperatures and pressures on the basis of one-half the stress required to obtain 2% creep in 50,000 hr. (extrapolated from 10,000 hr.). Thus, you don't have to wait any longer if you want to install a well-engineered, compatible, PVC pressure piping system.

F. J. STAUDT has been with Du Pont for 25 years; his current position involves design, development and engineering consultation in the engineering department. Staudt, a representative on ASTM D-20 Committee for Plastics and a member of ASA B16.12, is chairman of Du Pont's standards subcommittee on nonmetallics. He holds a B.S. from Carnegie Tech and is a member of Tau Beta Pi.





Surplus Searchlight Makes Solar Furnace

Need high temperatures without contamination? If so, a solar furnace may be your answer. Here's a way to build one at a saving.

★ **Winner of the April Contest by**

Paul G. Herold

Radio Corp. of America, Electron Tube Div., Lancaster, Pa.

The chemical and physical laboratory of our Electron Tube Division at Lancaster, Pa., has recently completed construction of a solar furnace made from a wartime surplus 60-in. anti-aircraft searchlight. The new furnace will be used in investigating various high-melting compounds and metal-oxide combinations.

As we received it, the searchlight still had its original high-speed azimuth (horizontal-movement) and elevation drives and electrical control facilities. These required considerable modification, along with the development of means for making the furnace track the sun automatically, for supporting and remotely positioning the sample, and for controlling temperature at the sample.

Small reversible d.c. motors with geared speed reducers control the elevation and azimuth of the furnace. The elevation drive, shown at the right of the mirror, tilts the mirror at the rate of 2.46°/min. The azimuth drive, at the base of the mirror, turns the mirror at 16.9°/min. The original selsyn system which came with the unit might have been adapted to automatic tracking but would not have been accurate enough for our purposes. (In one such converted searchlight the tracking error was reported to have been 2 in.)

The tracking method adopted for the Lancaster furnace uses a specially designed cadmium-sulfide sintered cell as the sensitive element. Currents from the cell actuate relays to control the azimuth and elevation drive motors. The system uses no selsyns or feedback and produces a step-type movement of the mirror but the tracking accuracy is ± 0.01 in.

The accompanying diagram illustrates the operation of the sintered cell. It is mounted on the optical axis of the mirror, 14 in. behind a metal cap with a ⅛-in. circular aperture. A suitable filter for the 5,800A wavelength to which the cell is most sensitive is mounted in front of the aperture.

When the plane of the furnace mirror is normal to the sun's rays, the light spot from the aperture strikes the dead spot *D* at the center of the cell. With movement of the sun, the light spot impinges on one of the areas outside *D*, producing a cell output which causes the proper direction of motion of the mirror.

In more detail, as the sun goes higher before noon, the light spot moves downward on the cell, into the sensitized area between terminals *A* and *D*. Resulting cell current closes a relay which in turn energizes the elevation drive motor to tilt the mirror upward. This movement continues until stopped by the light spot

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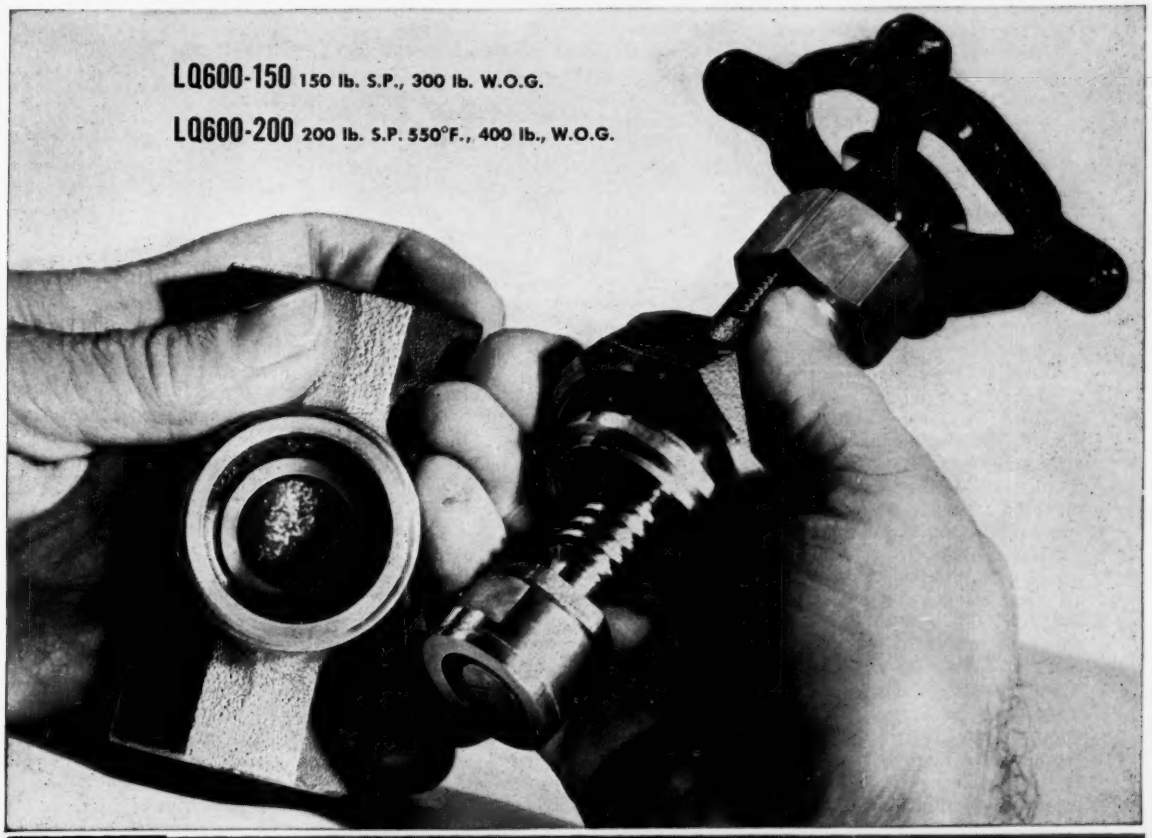
Long accepted valve maintenance costs have gone down in thousands of plants where Lunkenheimer Valves are in service. This record is due partly to the high standards of quality and workmanship in the valves themselves. But just as important, it's due to the outstanding service performed by Lunkenheimer Distributors the country over. No matter how good the equipment you buy, it serves you best when it's backed by modern, dependable distribution methods. And that is exactly what you get when you rely on your Lunkenheimer Distributor. He maintains a highly-trained staff who make your maintenance problems their business. His job is to serve you . . . and he does it well. Call him. He will be glad to demonstrate the maintenance-saving benefits you receive when you install Lunkenheimer Valves.



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moving back to *D*. After noon, lowering takes place as the light spot moves into the area between *D* and *C*. Similarly, with apparent horizontal movement of the sun, the light spot moves into the area between *D* and *B*, resulting in a following movement by the azimuth drive motor. These movements can also be brought about by manual control.

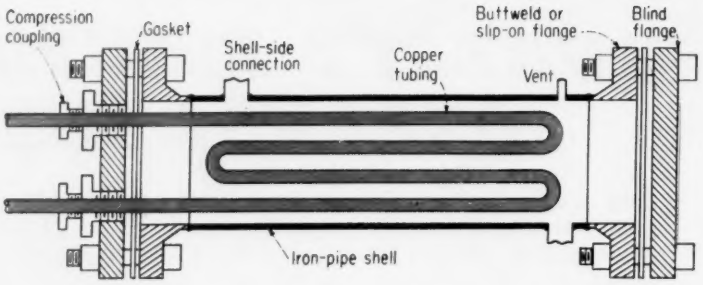
Samples, generally powders, are tamped into a 1-in. hole in a block of Transite. The block is supported on a jeweler's-lathe-type compound rest which provides movement in two planes at right angles to the optical axis of the mirror. The compound rest, in turn, is carried on the platform which originally held the searchlight's carbon arc. The platform can be moved in and out along the optical axis so the sample can be moved in and out of the focal spot.

Each of the three sample movements is powered by a small motor, with limit switches on each positioning mechanism. Any spot on the sample can be positioned at a point in a region 2.31 x 1.88 x 3.75 in. deep. Controls for these movements are manual, made from a point behind the furnace where the operator can sight the sample through a peephole.

Temperature control is accomplished by a cylindrical "diaphragm" which controls the amount of radiation reflected onto the sample. This 18-in. diam. x 24-in. cylinder is mounted on tracks, moving back and forth along the optical axis.

This cylinder is driven by a small reversible motor through an arrangement consisting of a floating gear on a threaded rod, which allows 12.75 in. of movement at a rate of 1.25 in./min.

So far, temperature measurement has been possible only through the melting of high-temperature materials of known melting point. This is because optical and radiation pyrometers are unable to distinguish between radiation from the sample, and solar radiation reflected from the sample. By melting chemically pure zirconium oxide, it has been established that the furnace can produce temperatures at least as high as 2,950 C.



Do-It-Yourself Heat Exchanger

R. F. Staples
Chemical Engineer, Naugatuck Chemicals, Elmira, Ont., Canada.

If you need a small heat exchanger or condenser in a hurry, the one shown in the sketch above can be built in any shop in a few hours and at very low cost.

The exchanger shell is a piece of pipe of suitable length and diameter, with flanges welded to each end. Holes are cut in the pipe and couplings welded on for shell-side fluid connections and vent. Enough copper tubing to provide the necessary heat transfer area is then bent as shown to fit inside the shell.

The two heads are made from blind flanges, that at the left being drilled and tapped to take suitable compression fittings with which the two ends of copper pipe can be made tight. For example, the Kwik-Tite compression fittings made by the Imperial Brass Mfg. Co., of Chicago, can be used.

The ends of copper tubing are passed through the compression fittings, a gasket is put in place and the blind flange bolted onto the end of the exchanger. After the tubing has been positioned properly inside the shell, the lock nuts on the compression fittings are tightened, locking the tubing in place. The blind flange and gasket are then installed on the other end.

This basic exchanger can be modified in various ways, such as by addition of baffles, or by use of shell-side connections through the blind flanges.

NEXT ISSUE: Watch for Winner of May Contest

★ How Readers Can Win

$50 Prize for a Good Idea—Until further notice the Editors of *Chemical Engineering* will award $50 each four weeks to the author of the best short article received during that period and accepted for Plant or Process Design Notebook.

Each period's winner will be announced in the second following issue and published in the third or fourth following issue.

$100 Annual Prize—At the end of each year the period winners will be rejudged and the year's best awarded an additional $100 prize.

How to Enter Contest—Any reader (except a McGraw-Hill employee) may submit as many contest entries as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable nonwinning articles will be published at space rates ($10 minimum).

Articles should interest chemical engineers in development, design or production. They may deal with useful methods, data, calculations. Address Plant & Process Design Notebooks, *Chemical Engineering*, 330 W. 42 St., New York 36, N. Y.

Materials are fed into top vibrating tier, drop down successively to bottom tier and leave through chute at lower left. System is enclosed to prevent heat loss and product contamination.

Jeffrey Vibrating Dryer

cuts pharmaceutical processing time 50%

BY CONVERTING from batch processing of pharmaceuticals, Abbott Laboratories has cut processing time in half for grinding, drying and sizing a variety of drugs. In addition, uniformity and control of the product is improved.

A Jeffrey vibrating dryer is the heart of the system which reduces moisture from about 24% to less than ½ of 1%. The dryer is a three-tier design, to conserve space and eliminate the need for intermediate handling.

Materials are conveyed by low-frequency vibration in the Jeffrey dryer. Speed of travel and depth of material can be varied as required. Operation is automatic. Holding time in the dryer is only 12 minutes; average feed rate 300-400 pounds per hour.

Jeffrey's broad experience in conveying and processing materials can help you cut processing costs. For information on Jeffrey products, write The Jeffrey Manufacturing Company, 909 North Fourth Street, Columbus 16, Ohio.

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MR. JUSTICE WHITTAKER (*standing first left*) wrote for the majority.

Collective Bargaining . . .

Supreme Court Decides in Your Favor

To protect the rights of engineers, an internal decision of NLRB has been upset by judicial review, destroying two decades of precedent in U. S. labor history.

By a vote of 7 to 2 in the case of Leedom vs. Kyne, the Supreme Court of the United States has struck down a decision of the National Labor Relations Board (NLRB) which would have limited your rights as an engineer.

In the Taft-Hartley Act, Congress specifically guaranteed to engineers the right to decide by secret-ballot elections whether they wish to be included, for collective bargaining purposes, in a group which is not entirely composed of professional engineers. (For details and definitions of terms, see *Chem. Eng.*, May 18, 1959, p. 190.) This secret-ballot election procedure is specified in Section 9 (b) (1).

Since 1947 NLRB has been mixing professionals with nonprofessionals in 3% to 31% rates of dilution. It is much easier, from the NLRB administrative viewpoint, not to separate nonprofessional employees from professional employees, particularly in the gray areas of job specifications and work qualifications. No one had challenged this NLRB practice until Engineers & Scientists of America (ESA) initiated this test case.

The case involved professional employees at the Buffalo (Cheek-

towaga, N. Y.) plant of Westinghouse Electric Corp. On a petition of the Buffalo Section, Westinghouse Engineers Assn. (ESA) to represent 233 professional employees, NLRB included nine admittedly nonprofessional employees. Although ESA won the election, it brought suit in the U. S. District Court to set aside NLRB's certification order because of the inclusion of nonprofessionals without the consent of the professionals.

NLRB moved to dismiss the case for lack of jurisdiction, since provisions of the National Labor Management Relations Act specifically foreclose judicial review of certification orders. Court review of all representation determinations would produce a large measure of industrial strife and might defeat national labor policy.

The District Court found that: NLRB had disobeyed the express command of Section 9 (b) (1) in including nonprofessional employees and professionals in the same unit without the latter's consent; in doing so, NLRB had acted in excess of its powers to the injury of the professional employees; and that the Court had jurisdiction to grant the relief asked for.

NLRB took the case a step higher to the U. S. Court of Appeals, and lost again. Then, because of the importance of the question of judicial review of NLRB decisions, the Supreme Court agreed to hear the case.

Strange Bedfellows

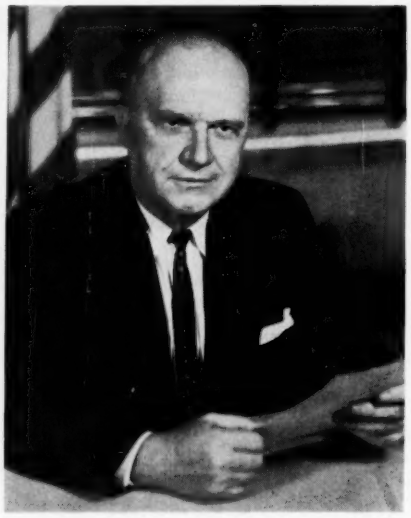
Along the way a paradox developed. The National Society of Professional Engineers, a staunch and consistent adversary of engineering unionism, decided to file a "friend of the court" brief in each court urging rejection of the NLRB claims and siding with the position taken by the engineering union plaintiff.

Passage of time doth, indeed, make strange bedfellows.

On Dec. 15, 1958, the Supreme Court by a vote of 7 to 2 affirmed the lower courts' decisions and ordered that a new certification election be held. The election was held on April 10 and a 67% vote was cast in favor of ESA.

Since ESA had won only a 56% vote in the previous election, union news releases are now claiming that the new 67% majority "provides substantial support to ESA's position that professional engineers prefer representation in a homogeneous unit."

An NLRB spokesman had this to say: "NLRB has made over 1,100,000 decisions and determinations in its lifetime. Until this case, no one has ever successfully challenged its authority. Undoubtedly, engineering employees are very different from other employees."



BOYD LEEDOM, *Chairman of NLRB, announced the unanimous decision.*

Collective Bargaining . . .

A Supervisor Must Supervise Somebody

Every engineer can't be a supervisor, otherwise you'd have "all Chiefs and no Indians."

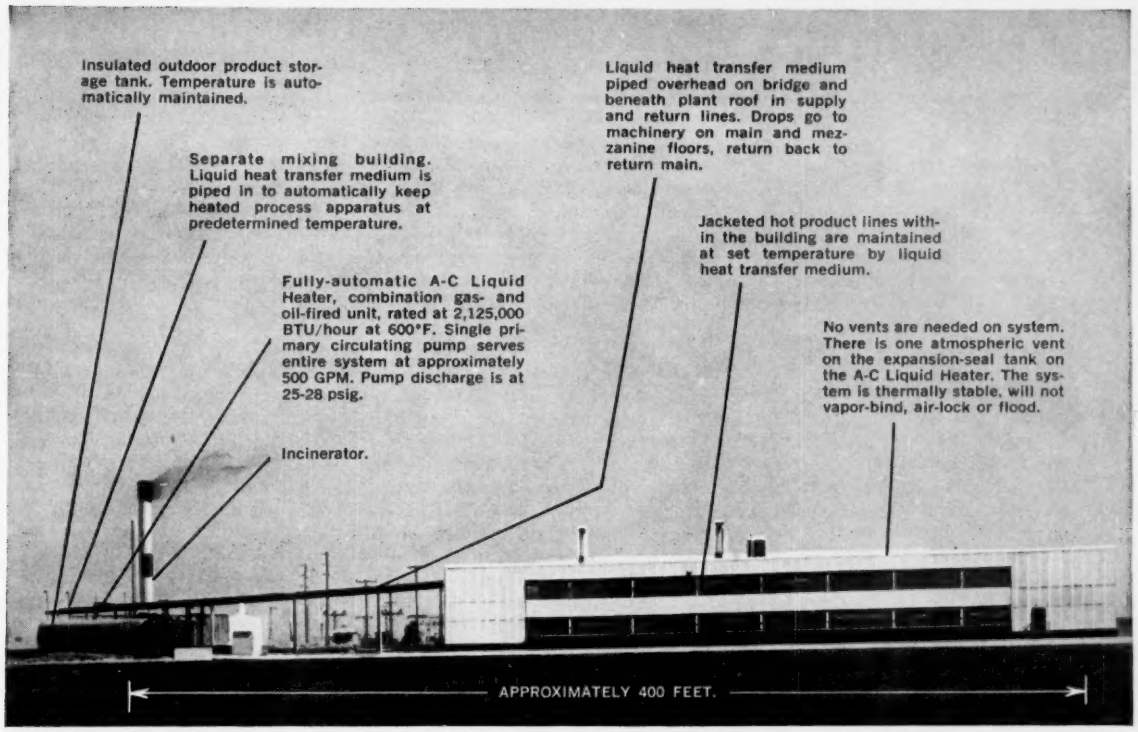
While setting the scene for a union-certification election among professional engineers of Pennsylvania Power & Light Co., Allentown, Pa., NLRB has reached a decision that will have a significant and widespread impact on the collective bargaining rights of all engineers.

At issue was this question: "When is an engineer a supervisor?"

The company contended that 53 engineers with the titles "senior project engineer" and "project engineer", etc., were supervisory employees, therefore not eligible for collective bargaining representation.

At PP&L, assignment of a project to a specific senior project engineer depends on the work load and the specialization of the engineer. If required by the work load, project engineers and junior engineers are assigned on a project basis to assist the senior engineer. All the engineers in the group work together on a given project, the senior men giving technical advice and counsel to the junior men.

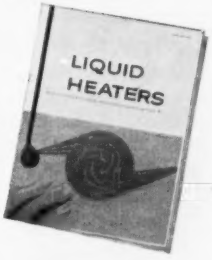
All engineers who work with assistants are required to make out merit rating reports from time to time on the work of their subordinates. This has a possible effect on salaries. Therefore,



HOW ONE ALLIS-CHALMERS LIQUID HEATER SERVES AN ENTIRE PROCESSING PLANT

In this West Coast plant, one Allis-Chalmers Liquid Heater automatically furnishes indirect process heat for all mixing and processing operations and outdoor storage tanks. The liquid heat transfer medium is pumped at low pressure for a distance of approximately 400 feet and returned by a standard, low-head centrifugal pump. All safety valves, relief valves and similar devices are eliminated, and there are no explosion hazards. A-C liquid heating systems provide maximum safety at minimum cost.

If higher processing temperatures, automatically controlled and delivered at low working pressures, can help you increase your output and cut production costs, you'll want to learn more about this liquid heating system. It is economical to install and operate, can be applied to existing equipment as well as new construction. For bulletins containing complete information, contact your nearest Allis-Chalmers office, or write directly to Allis-Chalmers, Hydraulic Division, York, Pennsylvania.



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ALLIS-CHALMERS

1103

says the company, the senior men are supervisors.

NLRB, in a unanimous decision entered into by Chairman Boyd Leedom, and members Stephen S. Bean and Joseph A. Jenkins, found that all but 5 of the 53 professional engineers claimed by the company to be supervisors "are not supervisors within the meaning of the Act, and we include them in the bargaining unit."

The Board's rationale was premised on the contention that the authority to give technical and professional guidance to less experienced engineers and to rate less experienced engineers on the merit of their performance does not meet the definition of "supervisor" contained in the Taft-Hartley Act.

Not Enough Indians

The Board also considered the question of the proper ratio of supervisors to rank-and-file employees.

"If we were to exclude the senior project engineers as supervisors, the ratio would be highly disproportionate. For example, in the department of the chief mechanical engineer if senior project engineers were found to be supervisors, there would be 4 supervisors to 5 nonsupervisors in the mechanical design division; 5 supervisors to 7 nonsupervisors in the civil engineering division. . . ."

In essence the Board reached the conclusion that everybody can not be a boss. Somebody must be left to be bossed.

Incidentally, the election went against the union (Utility Engineers Assn.—Engineers & Scientists of America) by a vote of 110 to 42. Of 153 eligible voters only one engineer failed to vote. Thus, the first attempt of ESA to secure a new collective bargaining unit since its defeat at Minneapolis-Honeywell in May 1957 has resulted in another sound thrashing.

Typical Engineering Unions Today

Employer and Location	Professionals Unionized
Radio Corp. of America, Camden, N. J.	1,800
Shell Dev. Co., Emeryville, Calif.	400
The Texas Co., Port Arthur, Texas	120
Western Electric Co., New York, N. Y.	5,500
City and County of Los Angeles	1,300
Convair, Gen. Dynamics, San Diego	3,300
Lockheed Aircraft Corp.	3,400
Westinghouse Electric Corp.	1,445
Boeing Airplane, Seattle, Wash.	5,800
Tennessee Valley Authority	1,915

Collective Bargaining . . .

Engineering Unions' Improved Image

Today, more engineers look with favor toward collective action to improve status.

This month the Bureau of Industrial Relations, Univ. of Michigan, will publish the results of interviews with more than 250 engineers and scientists on the subject of collective bargaining. Title will be: "Unorganized Engineers' and Scientists' Opinions of Collective Bargaining for Professionals Like Themselves."

Preliminary results of this survey reveal that collective action to improve their salary and social status is favored by about one in five of professional employees today. About half of those in favor (10%) think in terms of collective bargaining along union lines.

The rest (8%) think their professional societies could do more collecting and distributing of salary and related information to their members and management.

On the other hand, 50% were strongly opposed to any form of collective bargaining for professionals, while 29% were mildly opposed. Three percent had no opinion.

Other highlights in brief:

1. No significant difference in attitudes between scientists and engineers.

2. No significant relationship between an individual's performance and his attitude.

3. A decidedly significant correlation between how an individual feels about his salary and how he views collective bargaining.

Four chemical companies were included in the survey. All companies surveyed had substantial research and engineering departments of long standing.

We also recommend for immediate and "must" reading a report from the Industrial Relations Div. of the National Assn. of Manufacturers. Its title: "A Report to Management on Unionization of Salaried Employees."

NAM warns that white-collar unionization is a long-term problem and that industry has yet to face the real test of the coming full-scale union campaigns.

Among the obstacles to organization, in NAM's opinion, are the traditional reluctance of white-collar employees to join unions, and, most important, inter-union squabbles over jurisdiction. It cites as an example the split among engineering unions over the question of separate representation of professionals. If Engineers' and Scientists' Guild with 18,000 members and Engineers & Scientists of America with 25,000 had not been divorced, engineering unionism would be much further advanced than it is today.

NAM feels that the test of white collar loyalty will become the most important problem in industrial relations.

Erosion . . .

. . . pumping vanes of this impeller were virtually washed away. Note the gouging caused by the abrasive fluid. Strange as it seems, this pump still was the most economical for handling this slurry.

How to Extend Centrifugal Pump Life

. . . Erosion, Packings and Bearings: Causes and Cures*

NEAL B. HEAPS, Mission Mfg. Co., Houston, Tex.

In the first article in this series (*Chem. Eng.* May 4, 1959, p. 156) we covered what effects cavitation and corrosion have on centrifugal pump life, how to troubleshoot them and how to find cures. Now we'll go ahead a little further and examine erosion, packing wear and bearings.

Erosion Causes Trouble

Of more limited nature than cavitation and corrosion, but of equal importance in centrifugal pumps, is erosion.

Centrifugal pumps failing because of erosion have an "all gone" look as shown above and on p. 130. What's left of the metal surface is polished and frequently gouged. These gouges are smooth and deepest at points where velocities are greatest. Gouges form a pattern in the general direction of flow; and all sharp corners are rounded (photograph on p. 132).

Discontinuities in the fluid passage, such as vent or drain connections or exposed gasket grooves, are particularly vulnerable. This is because eddies are created and instantaneous velocities increased.

Erosion is wear resulting from the blasting effect of the fluid and is accentuated when abrasive solids are present in the fluid. The nature of the abrasive particles, their sharpness, weight, size and concentration in the carrying fluid influence the wear rate.

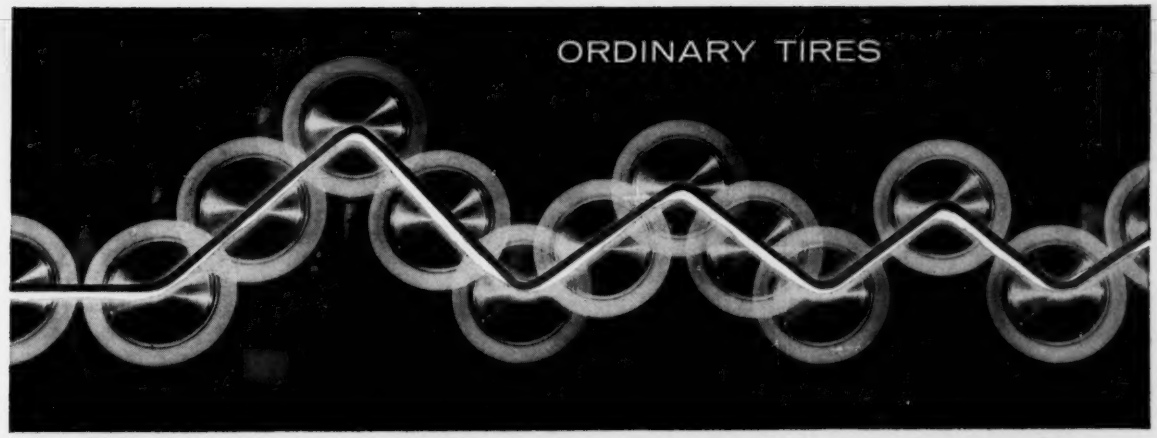
As the pump wears, the impeller clearances are increased and pump output is reduced. Pump designs that depend on close clearances for effective performance show the most rapid reduction in output.

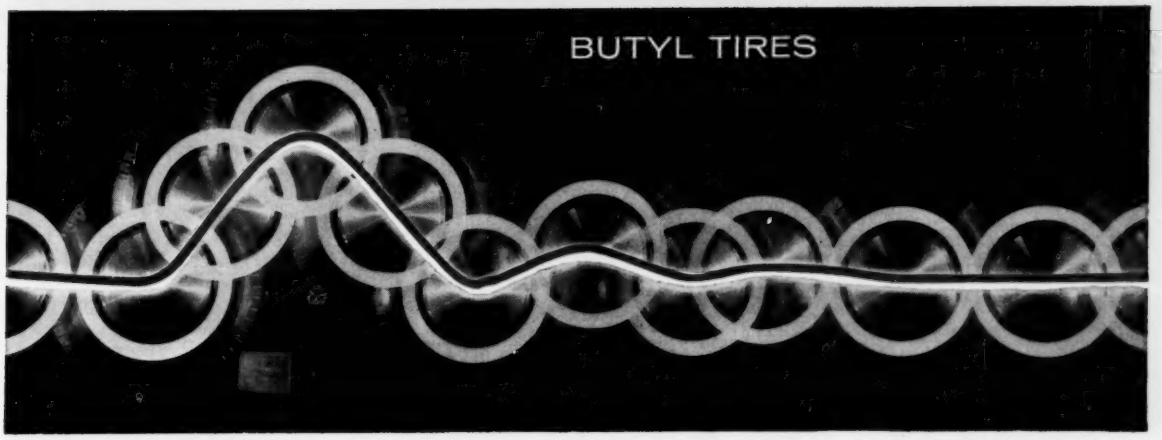
Where you must pump an abrasive fluid, a centrifugal pump is the most economical mover. A pump that does the job reliably and wears evenly throughout is probably applied properly and performing economically. Remember though, different materials of construction produce different pump service lives and the most economical material, on a dollars/day basis, is only determined by test.

However, a pump that's failed because of excessive wear at localized points is either the wrong size or the wrong design.

Basically, to minimize shutdowns resulting from pump

*** Part I on cavitation and corrosion appeared May 4.**





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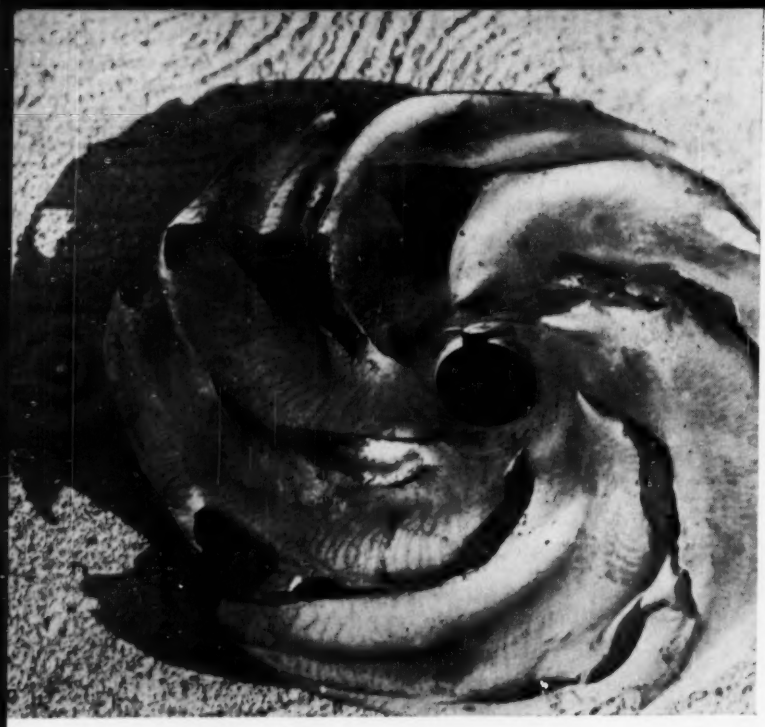


Erosion-Corrosion . . .

. . . these components wore out after long and faithful service. Note the smooth gouges. This slurry pump was still operating when removed from service.

wear, select a pump designed for slurry service. Slurry pumps don't depend on close impeller clearances, internal discontinuities are eliminated, fluid passages are large to minimize fluid velocities and impeller diameters are large so shaft speed can be low.

Packings Need Lubrication

Packing problems arise because of the difficulty in maintaining proper lubrication between the shaft and the packing.

A stuffing box is made up of a shaft passing through a close clearance hole; the nearer the hole size to the shaft size, the less the leakage.

It's necessary to lubricate this rotating shaft to prevent wear—just as a sleeve bearing is lubricated—and because it's impossible to put sufficient lubricant into any packing to last its entire life, some external lubricant must be supplied.

Unless the pumped fluid contains abrasive material, or for some other reason is an unsuitable lubricant, the most common method of providing needed lubrication is allowing leakage; and the most common cause of packing difficulties is preventing lubrication through overtightening.

Most popular type of packing for chemical process pumps is made of braided fibers (asbestos, plastic, flax, etc.) and a binder. This type of packing is referred to as self-correcting, or foolproof, because when overtightened, the rubbing shaft generates enough heat to melt the binder. This binder then leaks out, serving as a temporary lubricant and restoring the required clearance so the stuffing box can cool back to normal.

Then, of course, there's fluid leakage again, and if an overzealous operator tightens the packing (or more correctly stated, overtightens) the cycle is again repeated.

Tight packing, causing heat, means wear of the shaft as well as the packing. There's usually enough binder to allow packing to lose about a third of its volume, and then you must replace it.

In this case, the overzealous operator probably considers the process as a packing failure because it requires too much time to prevent leakage. Actually, the continual tightening is the cause of the excessive wear.

Fluids that chemically attack the packing or binder also soon cause excessive leakage; again overtightening is a fruitless pursuit. Selection of the proper packing is all that's necessary. Any competent packing supplier can provide a suitable packing if furnished with a complete description of the fluid you're pumping.

Where the pumped fluid isn't a suitable packing lubricant, it's common practice to introduce a lubricant directly to the stuffing box at the lantern ring and a spacer permitting this lubricant to reach the shaft at or near the center of the stuffing box.

Pressure must be sufficient to force this outside lubricant into the pump, preventing the pumped liquid from entering. Yet, not too high a pressure to cause excessive drip outside, or else the overzealous operator will tighten the glands too much and he's in trouble.

Clear water, oil, grease or any clear fluid that may be introduced into the product are satisfactory lubricants. Only a drop or two a minute is necessary, so limit the pressure to just slightly more than the pressure of the fluid within the pump at the stuffing box. A conventional pressure regulator is an excellent investment in this type installation.

It's virtually impossible to maintain packing or to seal against a rough shaft, so avoid scoring of the shaft through over-tightening or under-lubricating. Equally bad is pitting of the shaft under the packing. This can be caused by chemical attack or galvanic action.

Under certain conditions, electrolysis occurs between graphite packing and stainless steel shafting. In this case, use a packing containing some other lubricant, such as mica.

Clearly, higher fluid-pressure at the stuffing box means the rotating clearance must be smaller to control the amount of leakage, which of course, aggravates the problem. Pressures above 30-50 lb. are high for chemical process pumps.

Packing wear is increased where high, shaft peripheral

Erosion-Cavitation . . .

. . . handling an extremely abrasive material with insufficient suction pressure means cavitation and erosion. Most pronounced gouging is at points of lowest fluid pressure.

speeds exist; 1,800-2,000 ft./min. is high. Special packings are available for these special conditions.

Where slight leakage is dangerous or expensive, where fluid contamination is forbidden, where pressures or speeds are abnormal: consider a mechanical seal in place of packing. Selection of a mechanical seal should be made only by an experienced person.

Check pumps causing trouble because of packing failures; correct as follows:

- Choose correct packing, considering the specific application.
- Install properly, in a clean box, with the lantern ring properly positioned and each ring individually tamped firmly in place.
- Do not overtighten, allow some leakage.
- Lubricate properly.

Bearings

Bearing failures caused by misapplication are infrequent, other than for overloading; but some consideration of bearing failures is appropriate for listing here.

Bearings are used to withstand radial and thrust loads imposed by pumping. Mechanical unbalance produces excessive load, as does misalignment of the pump because of improper foundation or piping strains. Primarily, however, bearing loads are hydraulically created and the pump designer installs bearings adequately sized to survive any hydraulic loads encountered within the pump's normal operating range.

Excessive cavitation transmits excessive shock loads to bearings. Fluids containing solids that ball up and "slug" the impeller cause bearing damage. Fluid temperatures above the pump design range overheat the pump shaft that, in turn, overheats and breaks down the bearing lubricant. Improperly grounded motors produce stray electrical currents to initiate bearing failure. Remember, proper selection and use minimizes bearing failures of this type.

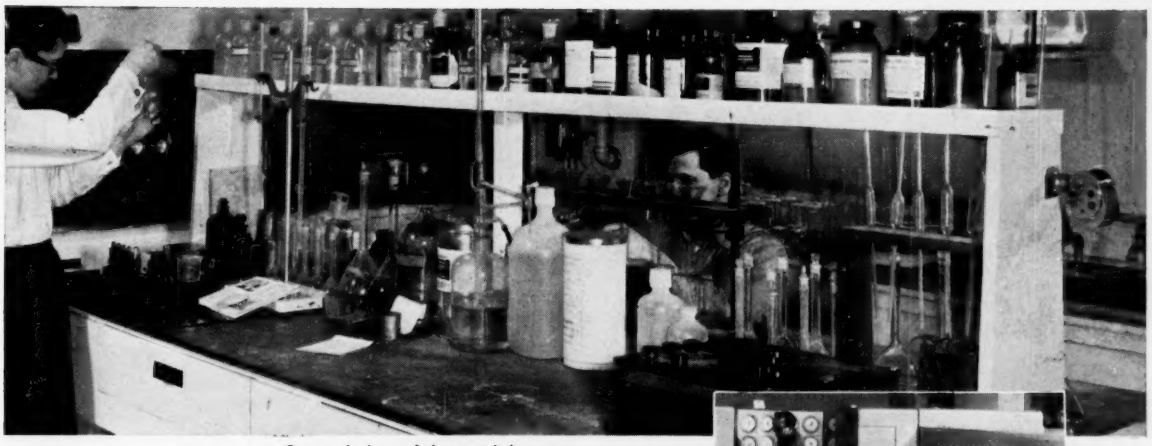
But by far the most frequent cause of bearing failure is contamination. The smallest piece of grit in a ball race can start complete failure. Moisture within a bearing enclosure causes rust and rapid bearing failure. Contaminated lubricants become ineffective.

You should follow these elementary rules during installation of ball bearings:

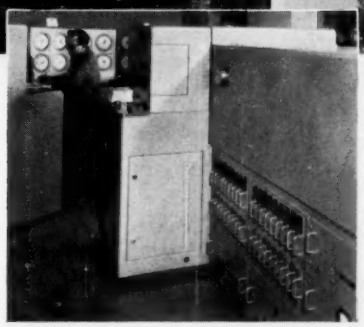
- Use a clean work surface: spread wrapping paper, clean tools, clean hands.
- Unwrap new bearings at the last minute. Don't wash.
- If reinstalling old bearings, wash with clear solvent, then in warm, light oil. Don't blow with plant air.
- Install square with shaft and housing. If you need excessive force, stop and check to insure no metal is being scuffed or rolled from the shaft.
- Press the inner race when installing on the shaft, the outer race when installing in the housing. Don't press through the balls.
- Be sure no lint, metal shavings, dirt or other foreign matter is left inside the housing.
- Install oil seals square with the shaft. Check condition of oil seal lip, spring, fit. Put oil or grease under lip to reduce friction and wear.
- Install water slinger properly, close to the bearing house, snug on the shaft.
- Lubricate properly.

To the maintenance man, these may seem small points, but extreme care in bearing-and-seal assembly is essential; the importance of cleanliness can't be overemphasized.

Again, the subject of bearings and bearing failures is a science in itself. Where a unique problem persists, return the bearings to the manufacturer, where the cause can be determined by careful examination.



General view of the wet laboratory



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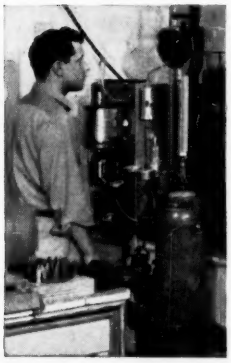

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EDITED BY R. B. NORDEN

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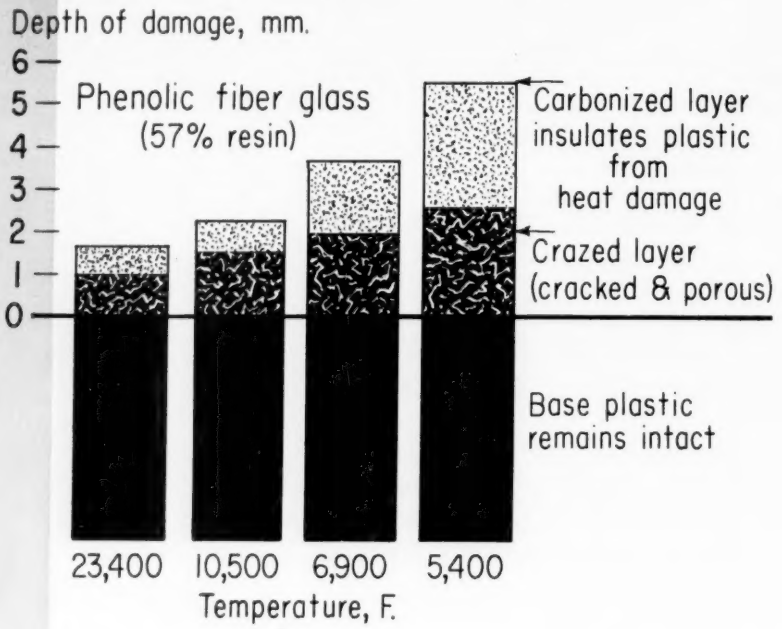


Plastics Take Ultra-High Temperatures

Here are the latest developments in the new field of plastics which stand up to temperatures above 1,000 F., where most metals and ceramics fear to tread.

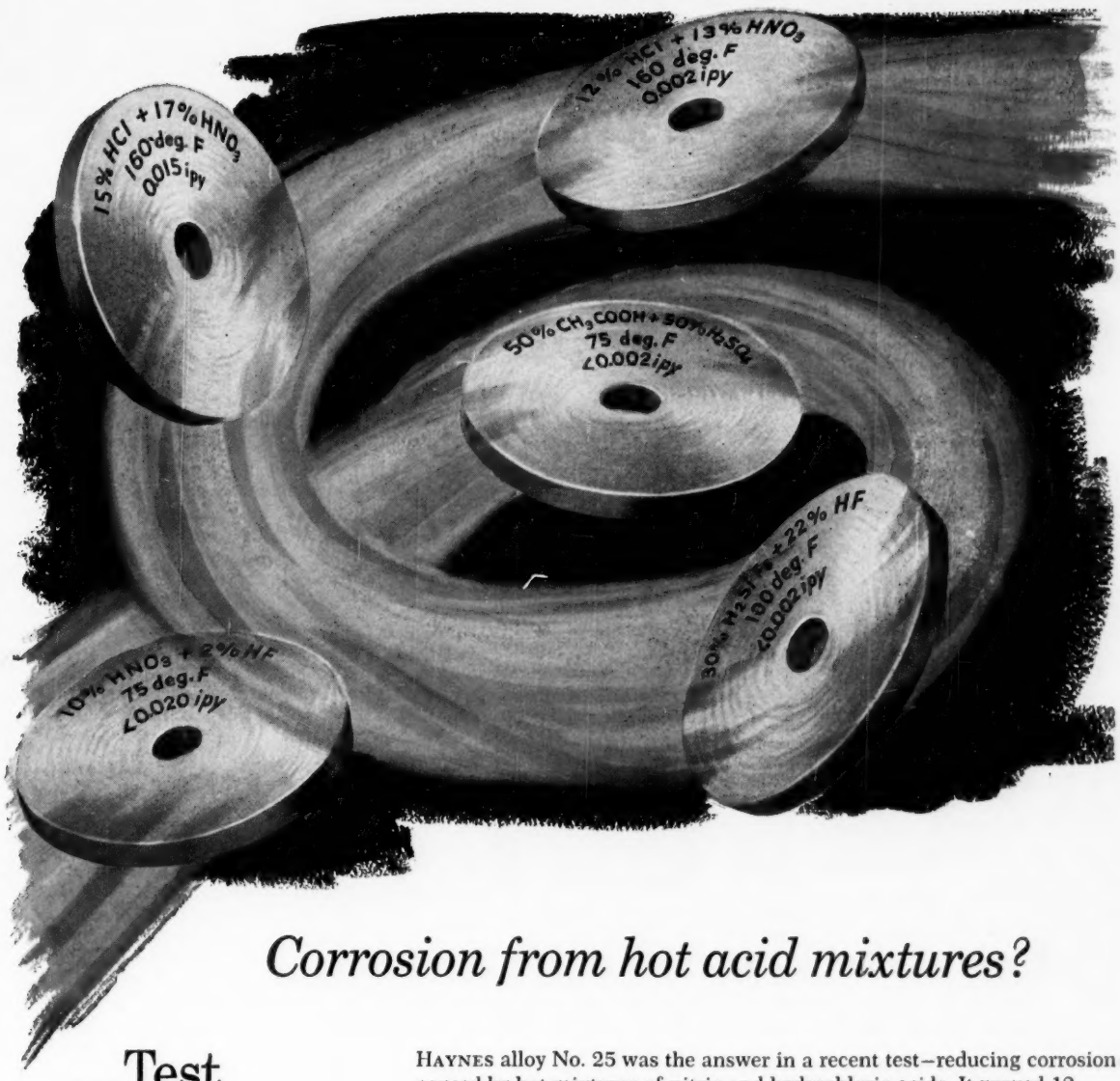
I. J. Gruntfest, Aerosciences Lab., General Electric Co., Philadelphia, Pa.

It is now clear that reinforced plastics can be useful in certain types of ultra-high temperature service, at least for short-time exposures (up to a few minutes at over 1,000 F.).

Our laboratory has been concerned with the protection of satellite and long-range missile vehicles from thermal damage during re-entry into the atmosphere.

A 5,000-mi. missile will be exposed to air above the melting and vaporization temperature of any known material. Furthermore, scientists are uniformly pessimistic about the prospects for discovering new materials which will be stable at this temperature. Organic plastics which are unstable at temperatures above 700 F. may be able to provide the necessary protection for these space vehicles.

▶ **Coke Protects Plastic**—As to the selection of specific plastics, those on which a coke-like shell develops on heating, such as the



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How Plastics Rate Under Severe Heat*

Table I

Material	Relative Weight Loss In Water-Stabilized Arc (7,000°K.) †
Graphite	0.81
Nylon-phenolic	1.2
Silicon carbide	1.7–6.3
Refrasil-phenolic	2.2
Glass-phenolic	2.2
Silica	2.3
Alumina	6.9–13.7
Mullite	8.22
Zirconia	12.9
Copper	60.0

* 10-sec. tests.
† 2,000 Btu./(ft.²) (sec.)

phenolics and certain epoxy resins, seem to be most useful. This result can be rationalized in the following way: The coke is stable at high temperatures; thus the driving gradients at the surface are reduced and back radiation increased. In addition, if, for example, all the carbon in a hydrocarbon composition is converted to elementary carbon, the other product must be hydrogen. This means that the largest possible volume of low molecular gas is available for blocking convective heat transfer. Furthermore, the coke layer may function as a furnace zone, where the primary products of pyrolysis are further decomposed into lower molecular weight gases.

The nature, amount and distribution of reinforcement must also be considered. Highly refractory fibers of alumina, silica and magnesia, are likely to be useful in some applications. In others, where higher temperatures are involved, the presence of inorganic material, however refractory, reduces durability. It is here that materials which are rich in hydrogen and also produce carbon on heating, such as nylon-reinforced phenolic, show the most promise.

One important point must be stressed in discussing these materials: the temperature of the environment to which the part is exposed is not an adequate definition of service requirements. Energy flux to the part, time of exposure and interactions of chemical and mechanical factors also must be taken into account.

▶ **High Durability**—Several hundred different kinds of metal, ceramic and plastic materials have been exposed in our facilities. Some of the observations have been summarized in an earlier article.[1] More are given here (*see Table I*). Notice in Table I that under very severe conditions of heating the relative durability of plastics is much greater than that of the usual refractory materials and is exceeded only slightly by that of graphite.

Table II shows[2] further that the ranking of a group of materials may be quite sensitive to the test conditions. In this table erosion rate of the most durable material in a particular exposure is given the value one. The other materials are then rated according to the ratio of their erosion rates to that of the best.

▶ **How Heat Works**—To understand this rather complicated pattern of results let us consider in a general way several things that may happen when a material is heated.

• Case I—A part exposed to a gas which is not too hot or has limited capacity to transmit heat to the surface. Here it is possible to generate an equilibrium situation in which there is no temperature gradient at the surface or the convective heat input is exactly balanced by radiation from the part before damage sets in. A small steel pin heated in a bunsen burner is a simple example of this case.

• Case II—A part exposed in such a way that the equilibrium temperature is above that at which some damage to the material occurs, let us say above the melting point of the material. Here a transient is first generated, the nature of which depends on the thermal diffusivity of the material and the geometry of the part. Until the surface temperature of the part reaches the melting temperature no damage occurs. Thereafter, a recession of the surface of the part, can be expected. Rate of this process will depend on the heat input, viscosity of the melt and the shear stress to which it is exposed, and the over-all heat-absorbing capacity of the material (including the latent heat of fusion as well as the variables that determined the nature of the transients). A rod of glass heated in a gas-oxygen flame would be an example of this type of behavior.

• Case III—Heating is sufficiently severe to produce some vaporization of the material. This case includes materials that are not expected to show a liquid phase (carbon which sublimes at ordinary pressures). Here again a transient will be generated during which no damage occurs followed by an erosion process. For analytical purposes it is useful to distinguish this from Case II because gas generated during erosion thickens the boundary layer and reduces effects of heating from the hot gas. Furthermore, to the extent that the material vaporizes, the latent heat of vaporization must be added to the effective heat absorbing capacity.

• Case IV—The nature of the material and/or the environment is such that chemical reactions can be expected. Here

How Plastics Erode at High Temperatures

Table II

Material	Resin, %	Relative Erosion Rates 1,800°C	2,500°C.	7,000°C.
Phenolic-glass cloth	27	1.0	2.7	2.5
	37	1.2	2.5	2.0
	44	1.6	2.2	2.0
	65	1.7	1.5	1.4
Phenolic-Refrasil cloth	41	1.4	1.0	2.1
Phenolic-nylon cloth	57	4.7	2.5	1.0

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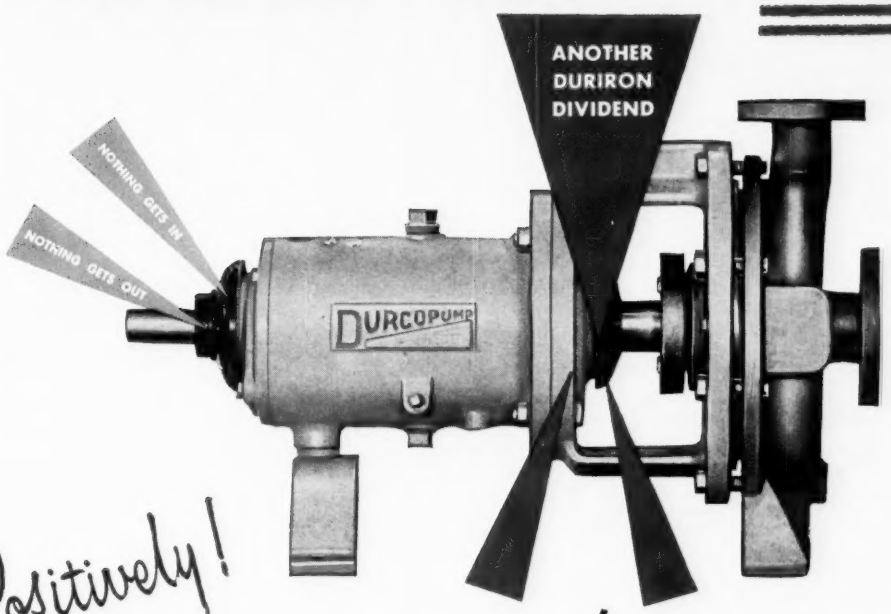

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there may be a critical surface temperature above which these processes occur at significant rates. Under these conditions the outcome will depend on the specific chemical situation in the test.

Clearly it would be very remarkable indeed if relative durabilities of materials did not change with service conditions which involve different thermal stabilities, test times, energy fluxes, radiation balances, thermal diffusivities, phase changes and chemistry.

As severity of the service conditions increases, behavior of any one material falls progressively into Case I, II, III and IV, although Case IV may be relevant earlier than II or III. Since plastics as a class begin to decompose at low temperatures (below 1,000 F.) relative to the so-called refractory materials, behavior of plastics never falls into Case I in the areas of interest for this discussion.

However, since plastics have lower thermal diffusivities than any other materials, damage that is done as the Case II and III situations develop may involve only that part of the material near the heated surface. Thus the mechanical integrity of the part may be relatively unimpaired during a short heat exposure.

► **Heat Absorption**—Thermosetting materials do not melt in response to heating so they pass immediately into Case III. Of the thermosetting materials, some decompose or pyrolyze in such a way as to generate large volumes of gas but also produce a porous coke-like residue which may have poor thermal conductivity. The coke forming materials do indeed seem to be more suitable for high temperature service. Of course in an air environment, the gases generated by the heating can react chemically as can indeed the coke residue. Heating experiments conducted on plastics thus are usually covered by Case IV.

If the environment is extremely hot and can deliver very large amounts of energy to the surface of material for a protracted period of time, durability of the material must finally be related to its ability to absorb heat. The heat absorbing capacity of a material is, of course, merely its integrated specific heat from the initial to the final temperature.

At high temperature, reliable estimates of the specific heat and its integral can be made for any material by more or less standard physical-chemical methods. These integrals have been estimated for various materials and presented in an earlier article.[2] It is shown in Table III that organic plastics can, in general, be expected to have higher heat absorbing capacities than any other structural material.

► **Compare Plastics**—Of course, not all plastics behave in the same way. Some form liquids on heating, others are converted to coke-like residues and gaseous products. Polytetrafluoroethylene (Teflon) can be gasified without forming either liquid or coke.

► **Important Resins, Fillers**—As a practical matter, homogeneous plastics are not finding application in high temperature service. Composites, containing fibrous reinforcing material, are usually the materials of choice. Examples of resins useful in high temperature service are: silicones, phenolics, melamines, epoxies, polyesters, nylons. Some popular fillers: glass, Refrasil (high-silica fiber made by H. I. Thompson Co.), nylon, and asbestos.

Amount of reinforcement is frequently about 50% by volume and, allowing for the differences in density, these composites may be only 25-35% by weight of the plastic itself. Obviously nature and distribution of the reinforcement is relevant to performance. In fact, it has frequently been suggested that in some applications the function of the plastic is merely to hold together small pieces of refractory ceramic which in massive form would not be strong enough or resistant enough to thermal shock to provide a stable structure.

The data shown in Table II show that this is certainly not always the case. Furthermore, in gas at 1,800 C. both glass and Refrasil show Case I behavior and the two types of reinforcement have equal merit. Nylon melts and decomposes so it does poorly. At 3,000C. only Refrasil shows Case I behavior, and it enhances the performance of the composite. The Case III behavior of the resin becomes important in the materials containing glass and the higher the resin content the better the rating. At 7,000 C. all the substances show Case III (or Case IV) behavior. Here the difference between glass and Refrasil is lost again, and furthermore the high gas producing and energy absorbing capacity of the organic material are the controlling factors.

Compare Plastic's Ultimate Heat Absorbing and Gas Generating Capacities* Table III

Material	Heat Absorption, Btu./Lb.	Relative Gas Volume
H_2 (gas)	120,000	1
$(CH_2)_n$ (organic plastic)	43,000	0.21
$(CH)_n$ (organic plastic)	36,000	0.15
Graphite	30,000	0.08
Beryllium	17,500	0.11
Magnesia	9,900	0.05
Silica	5,000	0.05
Copper	2,880	0.016

* At 8,540 F.

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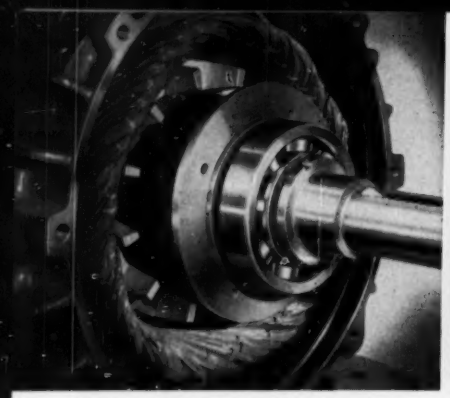
3. Gruntfest, I. J. Shenker, L. H. and V. N. Saffire, paper given at 14th annual SPI meeting, Chicago, Feb. 3-5, 1959.

Based on a paper given at the ASME Design Engineering Conf., May 25-28, Philadelphia, Pa.



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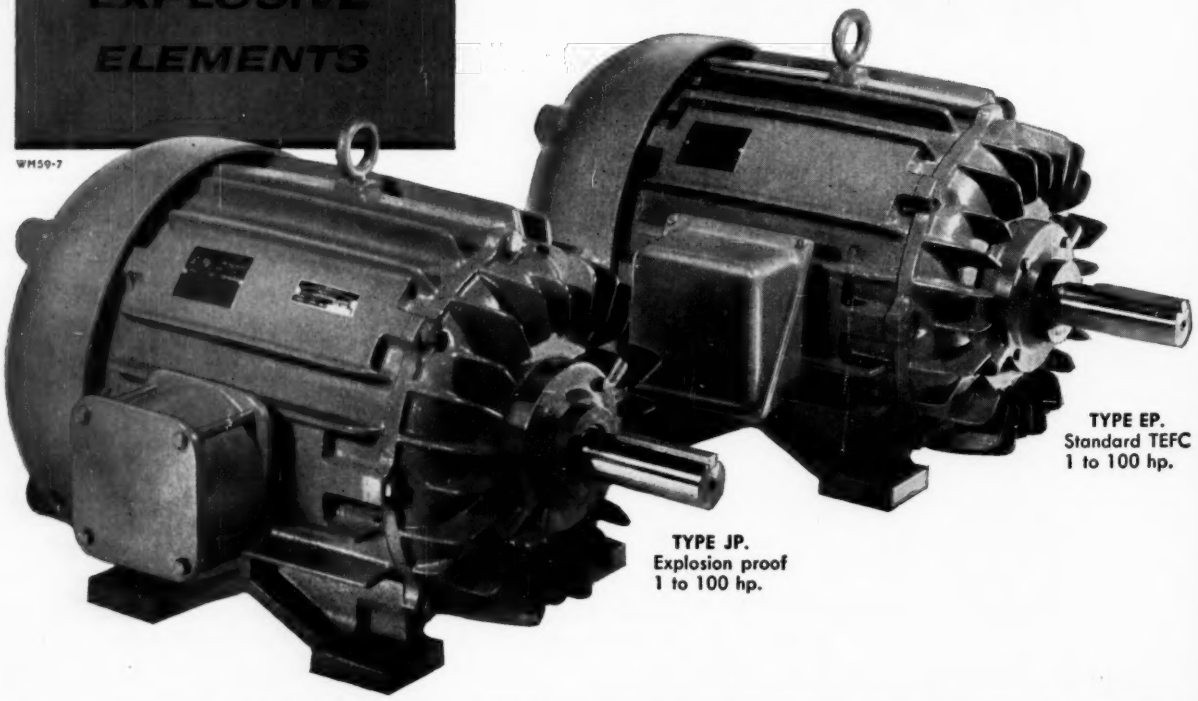

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FIRMS IN THE NEWS

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NEW FACILITIES

June's Top Projects:

Permanente Cement Co. will build a cement plant in the Waianae area of Oahu, Hawaii. Construction is scheduled to start within five months with completion scheduled for August 1960. Cost will be in excess of $12 million, annual capacity around 1.7 million bbl.

Texaco is erecting a 2,050-bbl./day sulfuric acid alkylation unit and a 600-bbl./day butane isomerization unit at its West Tulsa refinery. Units are slated to go on stream by November.

Fluor Corp. has been awarded contract by Pemex (Mexican government's oil monopoly) for construction of anhydrous ammonia and aromatic plants at the Minatitlan refinery. Cost will be around $20 million.

Air Products is erecting a $6-million plant at Glassmere, Pa., near Pittsburgh, for production of high purity liquid oxygen, nitrogen and argon. Initial operation is scheduled for the fall of this year.

Goodrich-Gulf Chemicals is operating a new $1.3-million facility in Port Neches, Tex., for producing 15 million lb./mo. of Ameripol Micro-Black synthetic rubber. This is a new kind of synthetic made by mixing the reinforcing carbon black with the latex while both are kept in a highly turbulent state. Process is said to give 15% longer life for rubber in tires.

Consolidated Mining & Smelting Co. is starting construction on western Canada's first iron and steel smelter near Kimberly. The $20-million facility will have a capacity over 100,000 tons/yr.; first stage will be in production early in 1961.

British American Oil will spend $1.5 million to expand capacity of its Nevis, Alta., gas processing plant from 15 to 25 million cu. ft./day. Plant is being expanded to process the B-A and Imperial Oil share of production from the nearby Nevis wet gas field.

Parke, Davis & Co. has construction under way on a new combined Baltimore, Md., branch office and warehouse. Structure, to be completed in early 1960, will contain about 40,000 sq. ft.

Hexcel Products has started a 20% expansion of its Berkeley, Calif., plant through leasing of an adjacent 20,000-sq.-ft. building. Hexcel is a manufacturer of honeycomb materials and products.

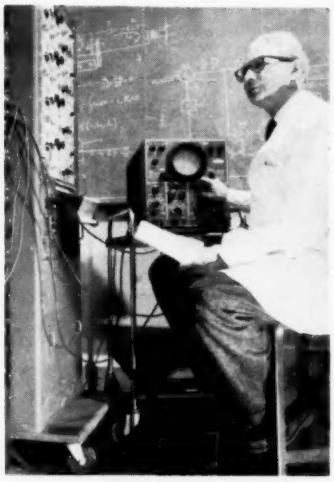
Pacific Plastic Products, a subsidiary of Cutter Laboratories, will build a $500,000 manufacturing plant in South San Francisco. New plant, which will house injection molding facility, will replace company's present quarters in San Francisco.

Carl H. Biggs Co., manufacturer of a line of epoxy ad-

FIRMS . . .

hesives for missile, construction and industrial uses, has opened a new 12,000-sq.-ft. plant in Santa Monica, Calif.

Westinghouse has signed a final contract with Societa Elettronucleare Italiana of Milan, Italy, to supply a nuclear steam generating plant for the Italian company's Enrico Fermi atomic power project. Scheduled to begin operation in spring of 1963, plant will have a capacity of about 160,000 ekw.



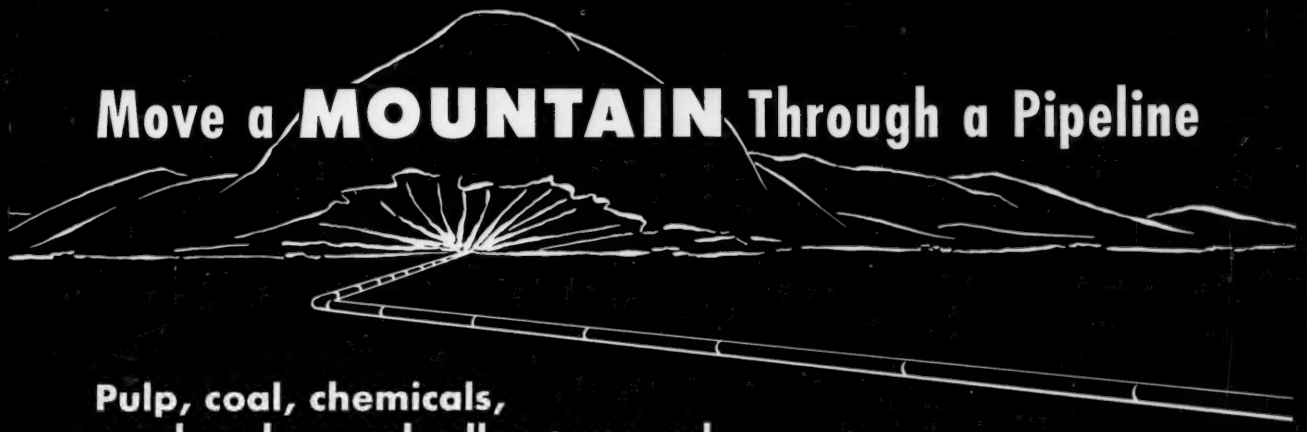
General Electric has opened a new advanced engineering center in Philadelphia, Pa., to study new equipment for static conversion of electrical power. Center houses around 20,000 sq. ft. of working area.

Atlantic Research Corp. has moved into the major three-story wing of its new $1-million headquarters building in Alexandria, Va. Other two wings will be completed shortly.

Chas. Pfizer & Co. is building an addition to its existing ascorbic acid plant at Groton, Conn. Target date for completion is the latter part of 1960.

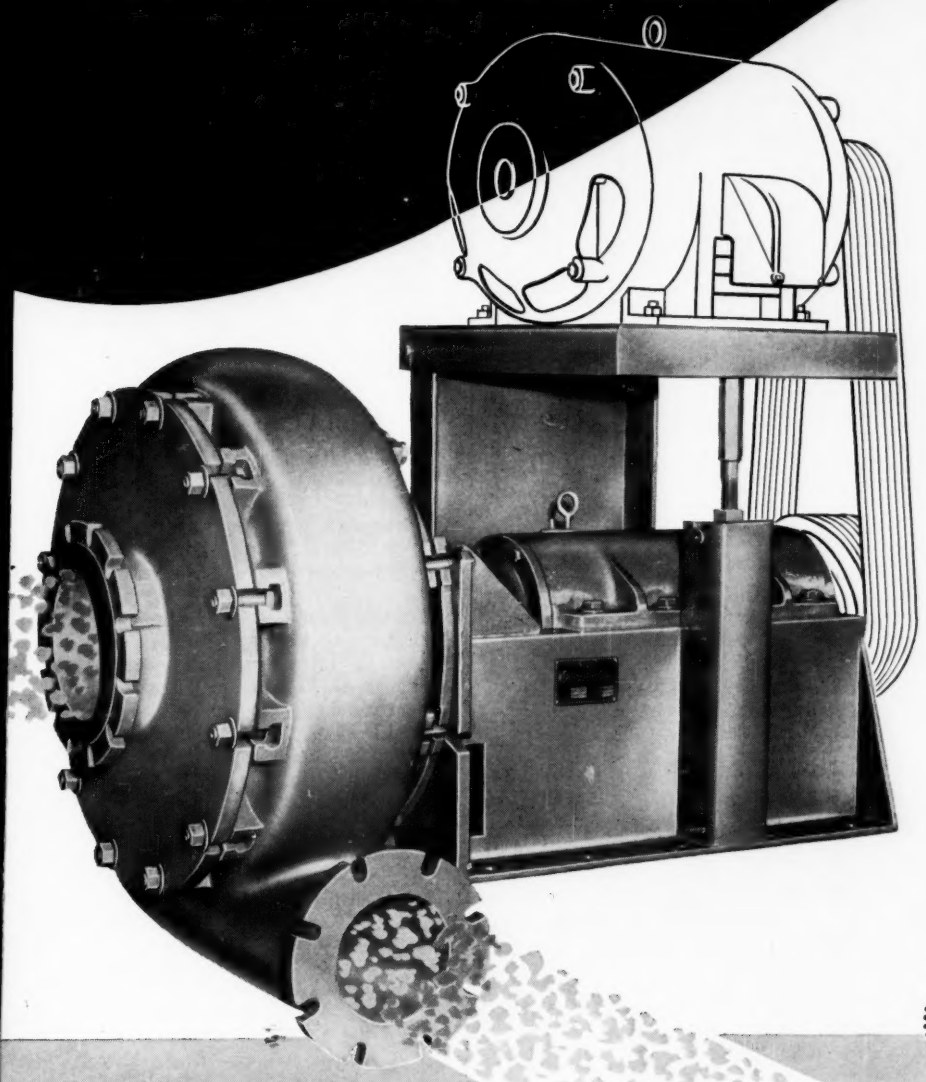
Aerosol Techniques has opened a new plant in Bridgeport, Conn., for manufacture of aerosol pharmaceuticals. Facility can produce all phases of pharmaceuticals, with spe-

Move a MOUNTAIN Through a Pipeline



Pulp, coal, chemicals, sand and gravel, all are moved quickly, efficiently and economically with

MORRIS Type CK Pumps



Hydraulic movement of materials can be simple, if you think in terms of a Morris Type CK Pump. A heavy-duty pump, with extra-wide clearances to handle larger random sizes, the Type CK is available in 4", 6", 8", 10", and 12" sizes. Engineered and constructed for long wear and resistance to abrasion and corrosion the Morris CK is available in semi-steel, ni-hard, cast steel or stainless alloys.

With the CK Pumps' low internal velocity, you get less turbulence, less abrasion, less wear and lower power costs. The Type CK features ease of maintenance, with extra clearances provided for easy replacement of packing . . . impeller readily accessible for inspection.

Morris maintains a nationwide network of centrifugal pump specialists, conveniently located to serve you. Their years of experience are invaluable when you plan a pump installation. For complete CK Specifications, and the name of your nearby Morris representative, write . . .

MORRIS MACHINE WORKS
BALDWINSVILLE, N. Y.

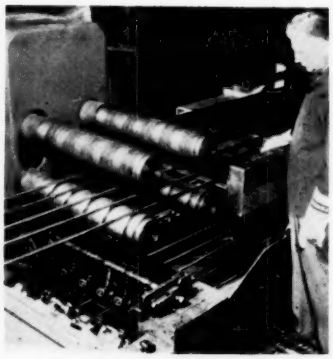
MORRIS
CENTRIFUGAL PUMPS

SALES OFFICES IN PRINCIPAL CITIES • EXPORT OFFICE: 50 CHURCH ST., NEW YORK 7, N. Y.

cial emphasis on pharmaceutical aerosols for inhalation.

Great Southwest Corp. has opened the first 200,000-sq.-ft. unit of the new distribution center complex near Dallas, Tex. Plans are for construction and operation of an additional 600,000 sq. ft. (three additional units) within the next three years.

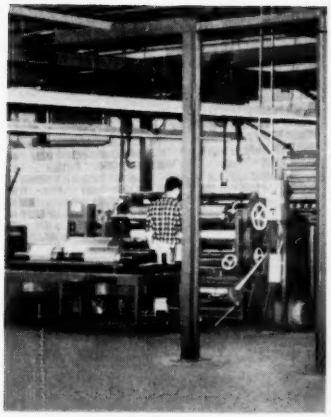
U. S. Radium Corp., Bloomberg, Pa., has expanded its facilities for fabrication of products utilizing radioactive tritium. Prototype production of special tritium-excited markers and light sources is also under way.



Scovill Mfg. Co. has opened a new tube mill in New Milford, Conn. Operator in photo above is checking operation of a 200-ft. multiple-position finish drawing bench.

Lukens Steel Co. has completed the largest single expansion of its 149-year history: At a cost of $33 million, firm increased capacity of its Coatesville, Pa., plant by 29% (to 930,000 ingot tons annually). Plate-rolling facility has been expanded 40%, making Lukens third largest producer of steel plate in this country.

Western Knapp Construction Co., San Francisco, has been awarded the construction contract for Federal Uranium-Radorock-Gas Hills Uranium's new 522-ton/day uranium mill in the East Gas Hills area of Wyoming (*Chem. Eng.,* May 18, 1959, p. 206).



American Viscose recently opened a new distribution center for Avisco cellophane just outside Dallas, Tex. Facilities are designed to provide custom service for the southwestern states.

U. S. Steel plans an expansion which will nearly double the stainless steel tubing capacity of National Tube Div.'s Ellwood, Pa., Works. Addition will add approximately 40,000 sq. ft. to the plant. Construction will extend over 18-month period.

Fluor Corp. has sold its wholly owned subsidiary, Midwest Metals, to Hydrometals, Inc., of New York, N. Y. Fluor established the company 18 months ago to develop a process for recovering copper powder from copper-bearing scrap and converting the powder to fabricated products. Fluor has also purchased a majority interest in a Dutch engineering firm and established a new subsidiary, Fluor-Schuytvlot in Haarlem, Holland.

Kaiser Aluminum & Chemical's stockholders have voted approval of the merger of Mexico Refractories Co. of Mex-

FIRMS . . .

ico, Mo., into Kaiser. Mexico Refractories will operate as a division in conjunction with Kaiser Chemicals Div.

Allied Chemical has acquired the Harmon Color operation of B. F. Goodrich Chemical Co. located at Haledon, N. J. Says Goodrich: "The organic color pigment business fits considerably better into Allied's operations than ours."

OVERSEAS BRIEFS

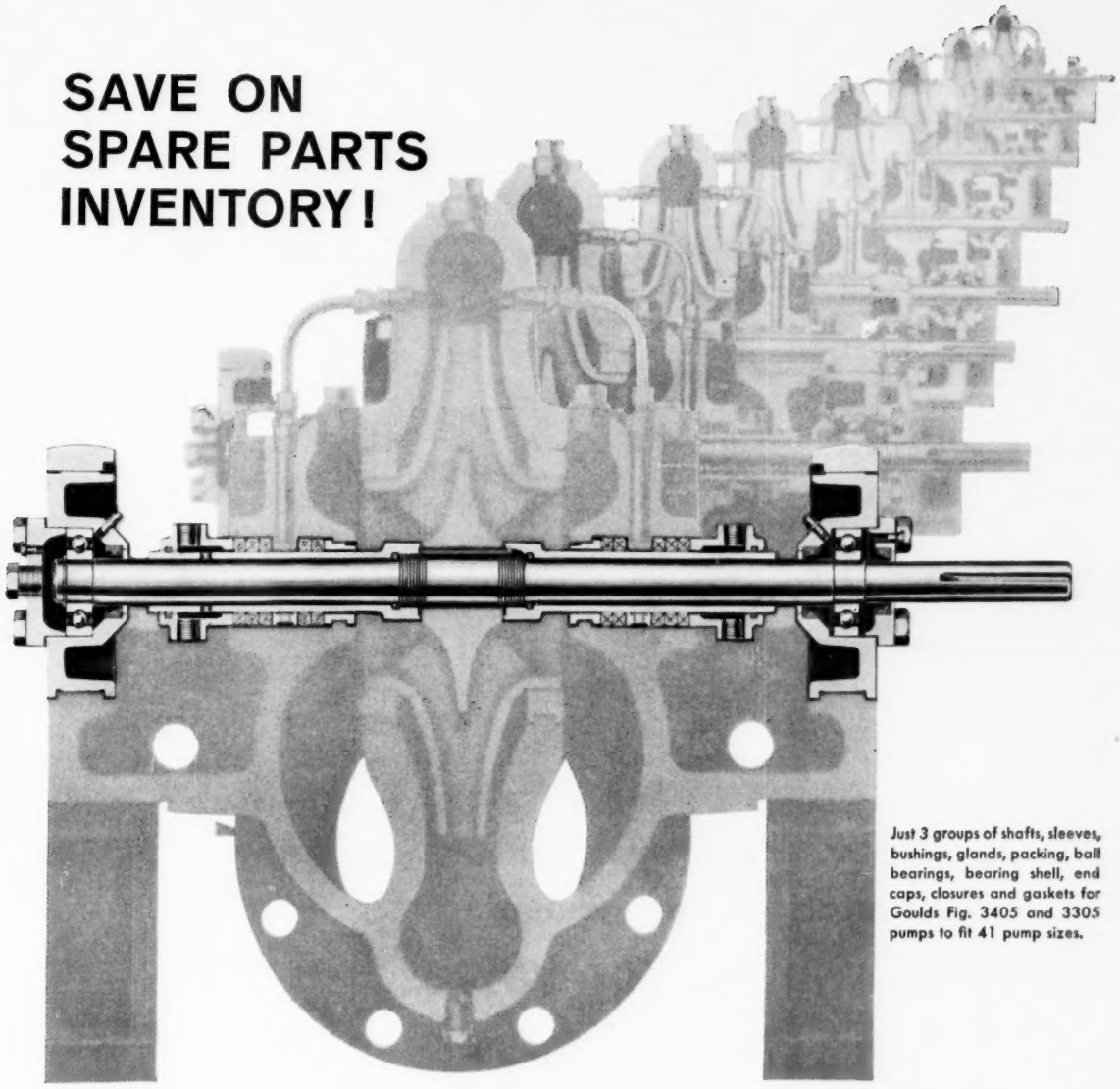
Montecatini is licensing Imperial Chemical Industries and Shell Chemical Co. to produce polypropylene in the United Kingdom under Montecatini and Montecatini-Ziegler patents. Both licensees announce that construction will start immediately.

Continental Carbon plans to construct a carbon black plant in Rotterdam, Holland, to cost approximately $2.5 million which will have an initial annual capacity of 15,000 tons of high-abrasive carbon black. Distribution of products will be handled through the worldwide facilities of Witco Chemical.

Tanatex Chemical Corp., Kearny, N. J., is one of the principal stockholders in a new Dutch firm, Tanatex Chemical (Holland) N. V., located near Amsterdam. Company will trade in chemicals for textile, leather and paper industries and will eventually produce these chemicals.

Societa Lepetit of Milan, Italy, has started operations in a new $2-million pharmaceutical plant in Mexico City. Plant is said to be the largest in Central America and will supply other Central American countries besides Mexican markets.

SAVE ON SPARE PARTS INVENTORY!



Just 3 groups of shafts, sleeves, bushings, glands, packing, ball bearings, bearing shell, end caps, closures and gaskets for Goulds Fig. 3405 and 3305 pumps to fit 41 pump sizes.

See how just 3 groups of parts fit 41 pump sizes!

High degree of interchangeability of parts on Goulds Fig. 3405 single-stage and Fig. 3305 two-stage Centrifugal Pumps helps you save four ways:

1. You cut down your spare parts inventory.
2. You can make changes in the field to meet new requirements.
3. Off-the-shelf delivery of standardized parts.
4. You can get lower initial cost, due to standardization of parts during manufacture.

Just three shaft and rotating parts assemblies provide for 41 sizes of these two popular pumps. You cut spare parts inventories *up to 91%*, save the cost of unnecessary overstocking.

Up to 82 pump combinations are possible—considering right- and left-hand rotation—and rotation can be changed in the field due to unique sleeve locking device (patented). Mounting dimensions and motor drive bedplates are standardized to facilitate changing without the additional expense of drilling and tapping.

And . . . you get all of this at low cost! Standard parts make manufacture less costly. Goulds passes on the savings to you.

Find out how this maximum interchangeability can save you money by sending for Bulletins 721.6 and 722.6, or ask your nearest Goulds representative.

GOULDS PUMPS, INC., Dept. CE-69, Seneca Falls, N. Y.

GOULDS

PUMPS FOR INDUSTRY

CALENDAR

Engineering Institute of Canada, annual meeting.
June 8-10 Toronto, Ont.

American Material Handling Society, national conference, Cleveland Auditorium.
June 9-11 Cleveland, Ohio

Material Handling Institute, annual exposition, Cleveland Auditorium.
June 9-12 Cleveland, Ohio

Instrument Society of America, 2cnd International Symposium on Gas Chromatography, Kellogg Center for engineering Education.
June 10-12 *East Lansing, Mich.

American Society of Mechanical Engineers, semiannual meeting, Chase-Park and Plaza Hotels.
June 14-18 St. Louis, Mo.

Manufacturing Chemists Assn., 87th annual meeting, The Greenbrier.
June 11-13 White Sulphur Spa., W. Va.

Technical Assn. of the Pulp and Paper Industry, New York Section, annual meeting, Whiteface Inn.
June 11-13 Lake Placid, N. Y.

American Nuclear Society, 5th annual meeting, Civic Auditorium.
June 15-17 Gatlinburg, Tenn.

Industry Gas Chomatography Course, University of California.
June 15-17 Los Angeles, Calif.

Gordon Research Conference: Separation and Purification, Colby Junior College.
June 15-19 New London, N. H.

American Society for Engineering Education, annual meeting, Carnegie Inst. of Technology.
June 15-19 Pittsburgh, Pa.

Canadian Pulp and Paper Assn., Technical Section, summer meeting, Manoir Richelieu.
June 17-20 Murray Bay, Que.

National Society of Professional Engineers, annual meeting, Commodore Hotel.
June 17-20 New York, N. Y.

American Society for Testing Materials, annual meeting, Chalfonte-Haddon Hall.
June 21-26 Atlantic City, N. J.

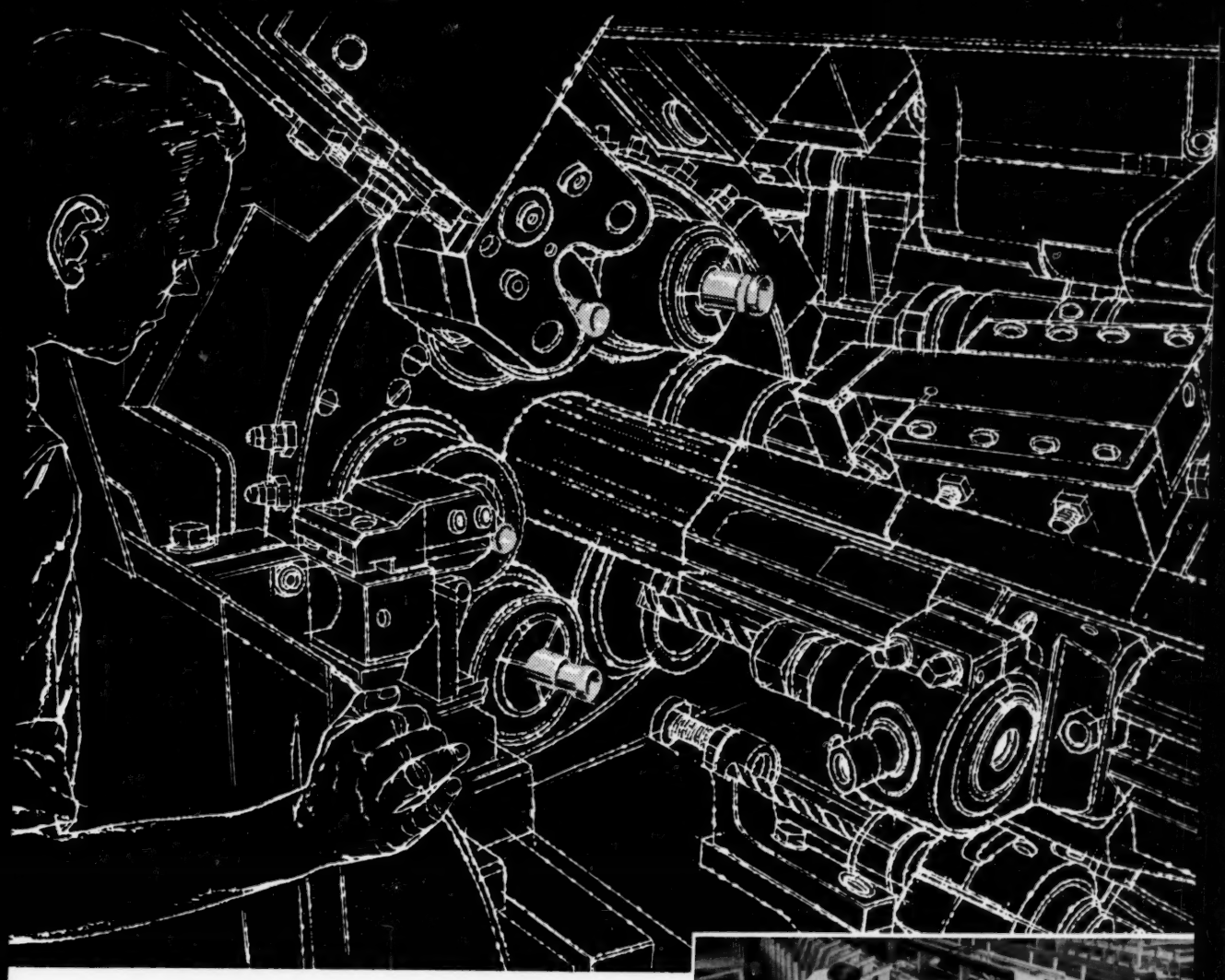
Canadian Gas Assn., annual meeting, Empress Hotel.
June 22-24 Victoria, B. C.

Air Pollution Control Assn., annual meeting, Hotel Statler.
June 22-26 Los Angeles, Calif.

American Assn. of Cost Engineers, 3rd annual meeting, Carnegie Inst. of Technology.
June 24-26 Pittsburgh, Pa.

Instrument Society of America, 2cnd Nuclear Instrumentation Symposium.
June 24-26 Idaho Falls, Idaho

(*Continued on p.* 150)



The Ultimate Test

The ultimate test of quality in stainless steel bars takes place in screw machine production, where every bar is literally cut to pieces.

The Perry-Fay Company, Elyria, Ohio, a leader in screw machine production, has been subjecting J&L bars to this demanding production-line test for more than a year, **without a single failure, without a single reject.** Perry-Fay reports: "We consistently get superior surface finish, closer tolerances, fully formed rolled threads with J&L stainless bars."

Whether you need stainless steel bar stock for high-speed, high-production operations, or a single bar for extraordinary requirements, turn to J&L. J&L leads the industry in melt shop standards for stainless steel, the point where quality starts—and new production profits begin.

Careful attention to every production detail is the key to J&L quality.

STAINLESS

SHEET • STRIP • BAR • WIRE

Plants and Service Centers:
Los Angeles • Kenilworth (N. J.) • Youngstown • Louisville (Ohio) • Indianapolis • Detroit

Jones & Laughlin Steel Corporation • STAINLESS and STRIP DIVISION • Box 4606, Detroit 34

CALENDAR . . .

Forest Products Research Society, 13th national meeting, St. Francis Hotel.
June 28-July 3 San Francisco

Gordon Research Conference: Polymers, Colby Junior College.
July 6-10 New London, N. H.

Society of Chemical Industry, 78th annual meeting.
July 6-11 Glasgow, Scotland

Foundation for Instrumentation Education-American Institute of Chemical Engineers, summer conference: process dynamics, Case Inst. of Technology.
July 6-24 Cleveland, Ohio

Gordon Research Conference: Organic Reactions and Processes, New Hampton School.
July 13-17 New Hampton, N. H.

Chemical Society of London, symposium on fluorine chemistry.
July 15-17 Birmingham, England

Gordon Research Conference: Radiation Chemistry, New Hampton School.
July 27-31 New Hampton, N. H.

Gordon Research Conference: Organic Coatings, Colby Junior College.
July 27-31 New London, N. H.

National Soybean Processors Assn.-American Soybean Assn., joint annual meeting, Sheraton-Jefferson Hotel.
Aug. 10-12 St. Louis, Mo.

American Pharmaceutical Assn., annual meeting. Netherland-Hilton Hotel.
Aug. 16-21 Cincinnati, Ohio

Gordon Research Conference: Chemistry and Physics of Metals, Kimball Union Academy.
Aug. 17-21 Meriden, N. H.

Technical Assn. of the Pulp and Paper Industry, 10th Testing Conference, Multnomah Hotel.
Aug. 18-21 Portland, Ore.

American Rocket Society, symposium: Gas Dynamics, Northwestern University.
Aug. 24-26 Evanston, Ill.

Gordon Research Conference: Instrumentation, Colby Junior College.
Aug. 24-28 New London, N. H.

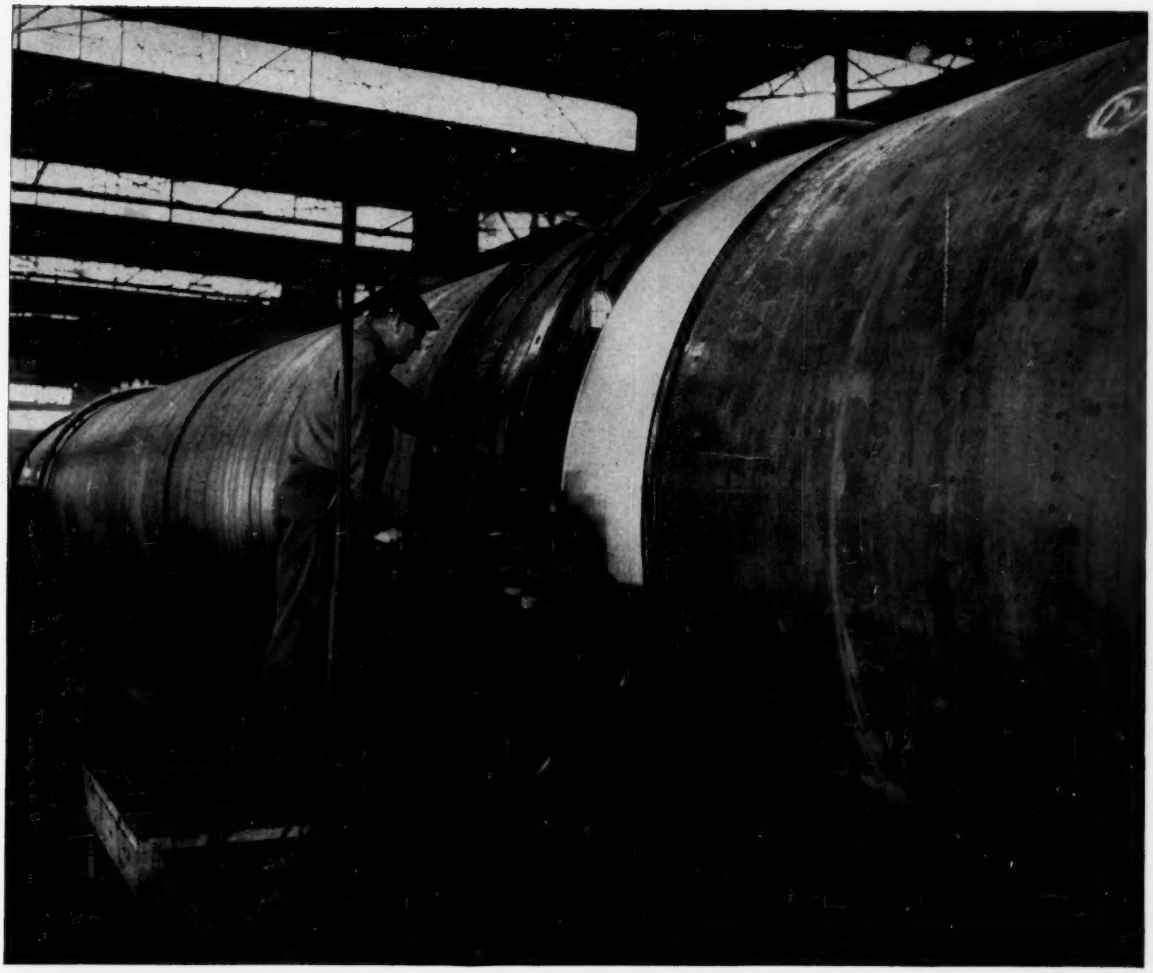
Chemical Institute of Canada, Physical Chemistry Div. meeting, McMaster University.
Aug. 30-Sept. 1 Hamilton, Ont.

Assn. for Computing Machinery, national meeting, Mass. Institute of Technology.
Sept. 1-3 Cambridge, Mass.

Cryogenic Engineering Conference, University of California.
Sept. 2-4 Berkeley, Calif.

American Society of Mechanical Engineers, International Air Pollution Congress, Statler-Hilton Hotel.
Sept. 9-10 New York, N. Y.

American Society of Mechanical Engineers, Wood Industries Div., national meeting.
Sept. 10-11 Portland, Ore.



Louisville Dryer—10 feet in diameter, 10 stories long!

Turn a ten story building on its side, and there'd be room to spare on either end of this huge pit lathe at Sharon, Pennsylvania where this 10′ x 110′ Louisville Dryer was fabricated.

This lathe is used for machining the reinforcing bands onto which are mounted the forged steel tires. This careful workmanship assures concentricity of the completed dryer shell—a primary factor in efficient seal operation.

Every Louisville Dryer is especially designed, manufactured, assembled and installed for its specific task.

If you have a problem involving process equipment, call or write our equipment specialist in your area. Here, as in so many fields, you'll find IT PAYS TO PLAN WITH GENERAL AMERICAN.

Process Equipment Division — *Louisville Dryers*

GENERAL AMERICAN TRANSPORTATION CORPORATION

135 South LaSalle Street, Chicago 90, Illinois
Offices in Principal Cities
In Canada: Canadian Locomotive Co., Ltd., Kingston, Ontario

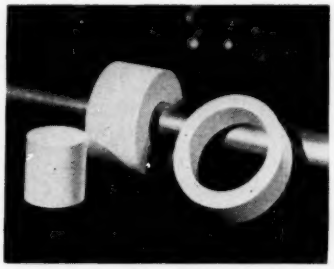
NEW EQUIPMENT . . .

(*Continued from p.* 68)

from one type to the other by simply substituting liquid-end assemblies.

Free-floating ball-check valves, enclosed in precisely dimensioned cages, are stacked vertically within the liquid-end housing; this arrangement gives improved flow characteristics, and allows easy removal of the valves for cleaning.

Standard models range in capacity from one drop every 13 strokes to 1,000 gph., at discharge pressures to 10,000 psi. Material specifications for wetted and nonwetted parts encompass a wide diversity of metals and plastics to allow selection of the proper pump for the required application.—**Clark Cooper Co., Inc., Palmyra, N. J.** **68D**

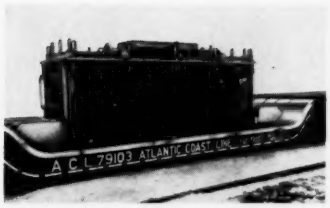


Journal Bearings

Made of Pyroceram. Show excellent form in tests.

Pyroceram journal bearings, introduced by Corning Glass Works, are capable of running with various metal shafts at operational loads under highly corrosive conditions. Corning says the bearings will neither contaminate nor be affected by most chemical fluids.

Tests showed that when a Pyroceram bearing part was run against itself or against currently accepted bearing metals, it showed less friction, less wear and less surface damage than other standard bearing materials. The tests were run in several corrosive fluids, including ferric chloride, nitric acid and hydrogen peroxide.—**Corning Glass Works, Corning, N. Y.** **152A**

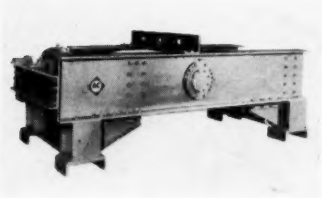


Shipping Containers

Radioactive wastes move over normal rail routes.

Nine massive shipping containers for transporting fissionable material and radioactive waste over normal shipping routes without radiation danger are being produced for E. I. du Pont de Nemours & Co. Each 75-ton unit sandwiches 8½-in. of chemically pure lead between ½-in. plates of stainless-clad steel to achieve the rigidity, strength and radiation-shielding properties required.

Welded to the outer surfaces of the vessel are solid stainless fins, 4 in. high, placed 1½ in. apart. Fins provide surface area necessary to dissipate heat generated inside the cask. — **O. G. Kelley & Co., Boston, Mass.** 153A



Car Shaker

Smaller unit for the smaller producer.

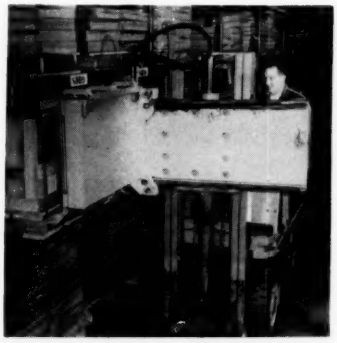
Allis-Chalmers has recently expanded its line of car shakers for unloading granular materials from open, hopper-bottom gondola railroad cars. The new shaker, a 3½-ton unit, will unload the same materials handled by the line's 5-ton unit—the unloading time, however, will be longer for sticky or frozen materials. Pushbutton-operated and driven by a 10-hp. motor, the shaker eliminates the need for men in or near the car. According to the manufacturer,

the unit is ideal for industries unloading 4 to 5 cars per day of granular materials. — **Allis-Chalmers Mfg. Co., Milwaukee, Wis.** **153B**

Stainless Fittings

Align easily with pipe for quick jointing.

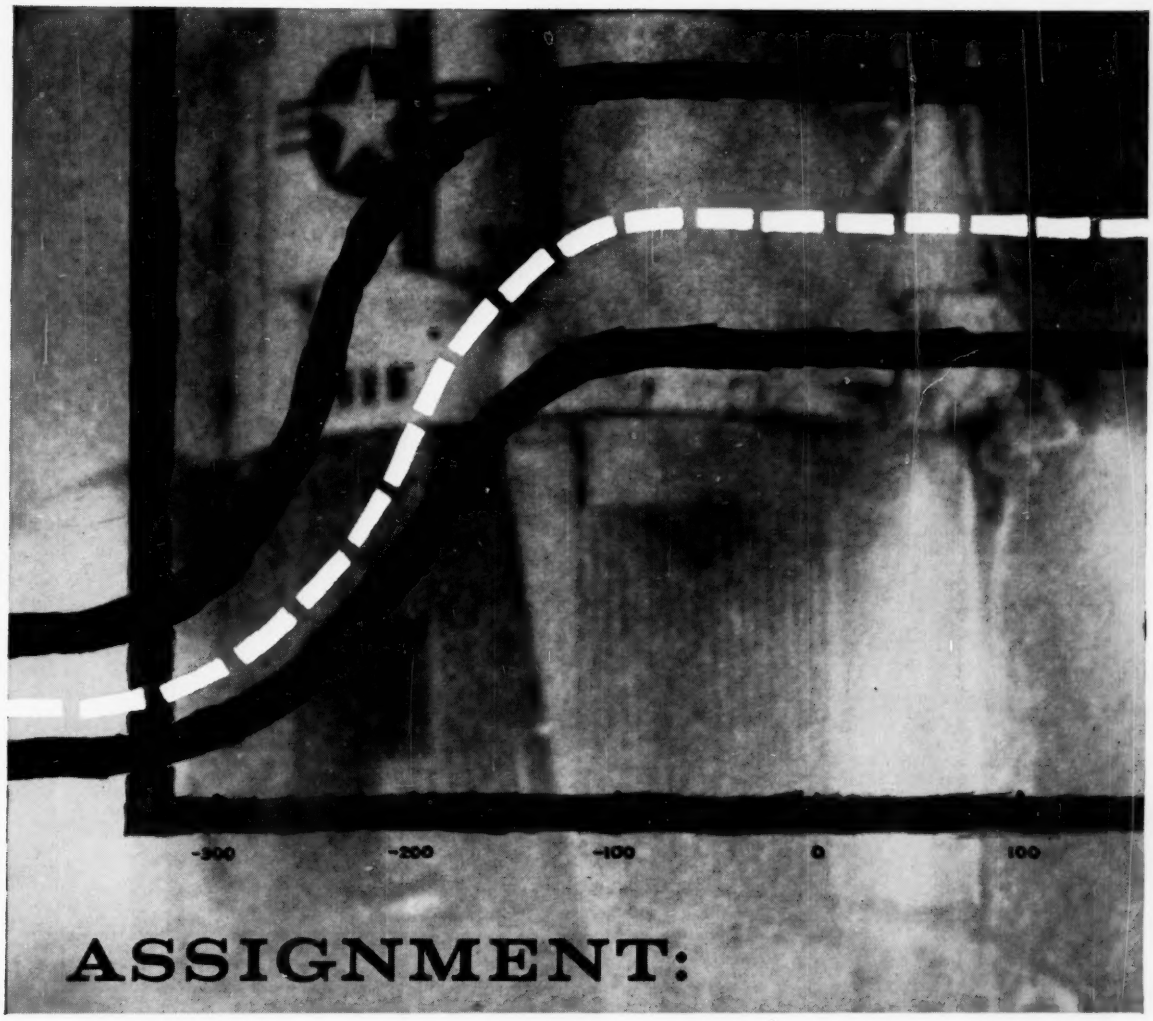
Swivel-type flanges and long tangents are features in a new line of light-wall, stainless steel fittings for nominal-temperature, low-pressure, noncriticial process piping. Low in cost, the fittings come in sizes ½ to 4 in., Schedule 5S and 10S. — **Tube Turns Div., Chemetron Corp., Louisville, Ky.** **154A**



Side Transfer System

Smaller aisle space means more storage area.

A new side transfer loading system may solve problems of materials handling and storage in areas where floor space is at a premium. Called STOW (Side Transfer Optimum Warehousing), the system makes use of a fork-truck attachment that



ASSIGNMENT:

CRYOGENICS

How Lukens *Application Research* helps you find the right steel plate for the job

If your assignment is designing equipment for extreme low temperature service—our Application Engineering staff can help you. They research problems of every description from the design stage right through to how the equipment has performed for years after its installation.

Missile components and liquefied gas tanks would be dangerously susceptible to cracking if made from ordinary steel. Seeking economical metals for such applications, Lukens engineers began years ago to watch the performance of nickel bearing alloys in a variety of low temperature equipment. Result: a broad understanding of metal behavior at various low temperature levels.

Examples: In the storage of liquefied oxygen, a tank of *Nine Nickel steel* provided more than eight years of trouble-free performance. Suitable to minus 320°F. service the steel showed no signs of cracking when removed for inspection. In frigid chambers for testing high altitude aircraft, *2½ percent nickel steel* is standing up well under pressures as high as 7,000,000 pounds. And in arctic locomotives operating at temperatures to minus 50°F. on rugged mountain roadbeds, main structures of *Lukens "T-1" Steel* have required no maintenance whatsoever.

Lukens Application Engineers know these cases . . . plus many more. *If your assignment is cryogenics, why not let it be our assignment, too?* Contact Manager, Application Engineering, H69 Services Building, Lukens Steel Company, Coatesville, Pa.

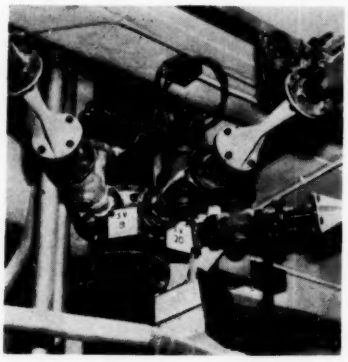
Helping Industry Choose Steels That Fit The Job

LUKENS ®

ASK FOR LUKENS NINE NICKEL STEEL BULLETIN

permits truck operators to pick up or discharge unit loads without the usual 90-deg. turn. This attachment fits any standard fork-lift truck.

STOW can cut aisle width to as little as 5 ft. The attachment handles pallets as well as skids, wire containers, and other materials normally requiring a fork truck for warehousing.—**Equipment Manufacturing, Inc., Detroit, Mich.** **154B**



Conveying System

Sound barrier holds flow constant in blowing lines.

A radically new system for pneumatic conveying is claimed by the manufacturer to be far superior to present, conventional methods. Known as the Simon Sonic conveying system, the development eliminates the necessity of providing a separate compressor for each blowing line.

Key to the new system's capabilities is a valve that, when installed in a blowing line, keeps the resistance of the line constant irrespective of the load. The valve consists of a convergent-divergent nozzle so proportioned that air passing through it reaches the velocity of sound. With a Sonic valve interposed between a loaded line and the compressor, any pressure wave traveling towards the compressor as a result of load change is halted at the valve's throat. Thus, whereas air flow in the lines of conventional systems decreases with increased load because of compressor characteristics, air

flow through the Sonic valve remains constant.—**Simon-Carter Co., Minneapolis, Minn.** 156A

Bayonet Heaters

Tantalum units have long life expectancy.

Tantalum bayonet heaters having heat transfer rates seven to eight times greater than those obtained with conventional bayonet heaters are now offered on a normal delivery basis. Life expectancy of the heaters under normal service is expected to be 20 yr., according to company officials. All seams are butt-welded, using the inert-gas arc method to eliminate weld contamination.

Wall thickness of the new unit is 0.013 in. The 1½-in. diameter bayonets are stocked in 1-, 2-, 3-, 4- and 5-tube bundle combinations; standard lengths are 12 to 72 in. Custom 2-in. diameter models are also available. The heaters can accommoderate internal pressures of 100, 150 or 200 psi., depending on model. — **The Pfaudler Co., Rochester, N. Y.** 157A

BRIEFS

Scraper for conventional disk filters folds or contours to the bellow of the filter bag. This assures complete cake discharge, even of very thin cakes. Wear on filter media is minimal.—**Peterson Filters &**

NEW EQUIPMENT . . .

Engineering Co., Salt Lake City, Utah. 157B

Optical pyrometer measures and records extremely high temperatures with milliseconds response time. The device can detect surface changes in temperature over an area of ⅜-in. dia. in the range of 1,400 to 3,000 C.—**Avco Research and Advance Development Div., Wilmington, Mass. 158A**

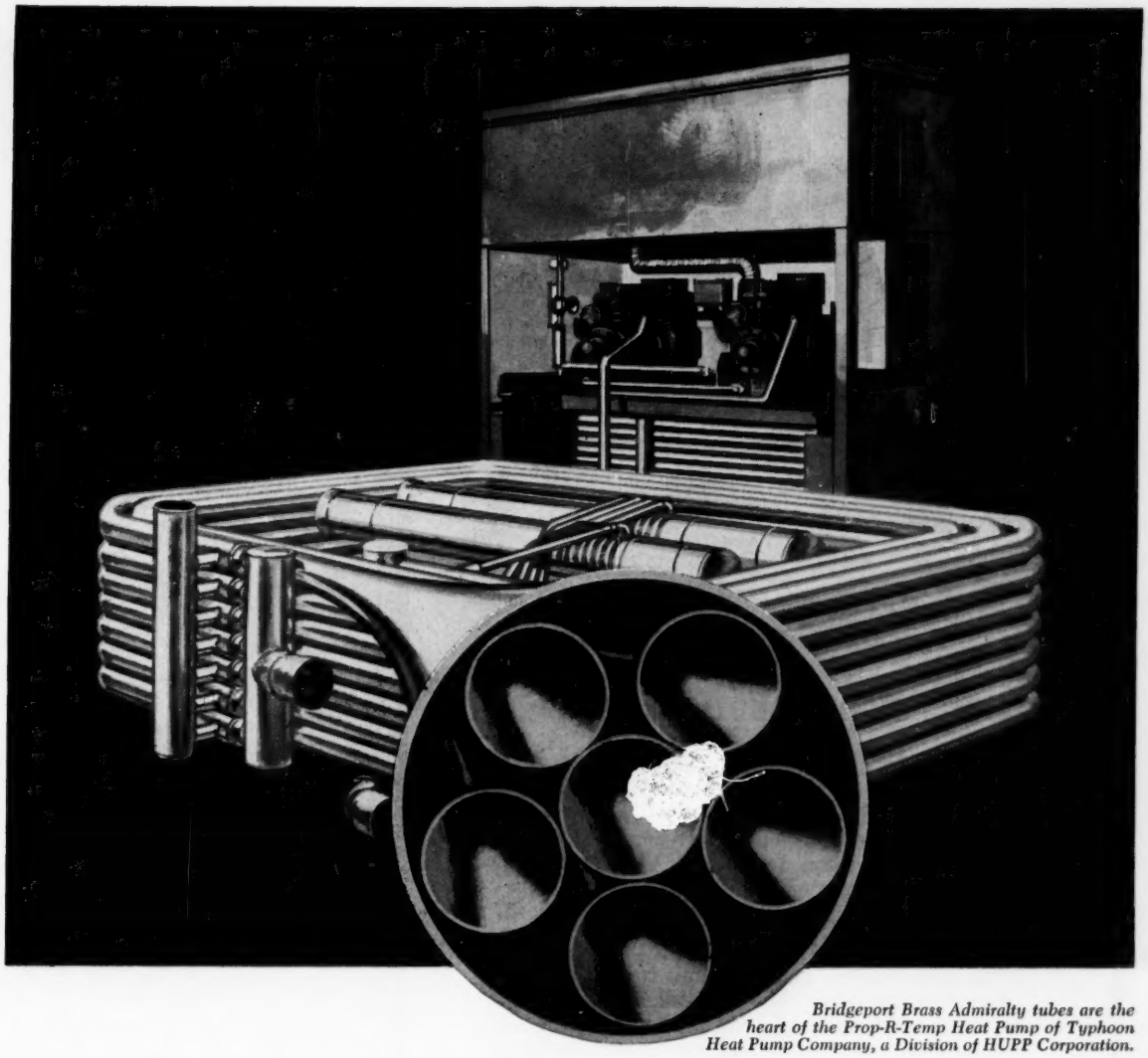
Flowmeter has an accuracy that is unaffected by variations of fluid viscosity from 100 to 750 SSU. Called the Tell-Tale, the unit is available in five maximum capacities, from 10 to 200 gpm. Maximum working pressure is 5,000 psi.—**The Rosaen Co., Hazel Park, Mich. 158B**

Centrifugal pumps and valves made of commercially pure titanium are available on order for corrosion service. Pumps will be offered with capacities from ½ gpm.; Durco Type K "Y" valves in sizes from 1 to 4 in.; Type "F" plug valves from ¼ to 3 in.—**The Duriron Co., Dayton, Ohio. 158C**

Equipment Cost Indexes . . .

	Sept. 1958	Dec. 1958
Industry		
Avg. of all	230.9	231.3
Process Industries		
Cement mfg.	223.3	223.7
Chemical	232.3	232.7
Clay products	217.0	217.4
Glass mfg.	219.3	219.7
Paint mfg.	222.8	223.1
Paper mfg.	223.8	224.2
Petroleum ind.	227.5	227.8
Rubber ind.	230.3	230.6
Process ind. avg.	228.6	228.8
Related Industries		
Elec. power equip.	236.0	236.4
Mining, miling	233.7	234.1
Refrigerating	260.3	260.6
Steam power	218.1	218.4

Compiled quarterly by Marshall and Stevens, Inc., of Ill., Chicago for 47 different industries. See Chem. Eng., Nov. 1947, pp. 124—6 for method of obtaining index numbers; Feb. 23, 1959, pp. 149-50 for annual averages since 1913.



Bridgeport Brass Admiralty tubes are the heart of the Prop-R-Temp Heat Pump of Typhoon Heat Pump Company, a Division of HUPP Corporation.

1,000 HEAT PUMPS PROVE THE DEPENDABILITY OF BRIDGEPORT TUBES

This remarkable Prop-R-Temp Heat Pump, a product of Typhoon Heat Pump Company , Tampa, Florida, heats, cools and dehumidifies. A key part of this unit is the tube-in-tube condenser coil which transfers heat from water to refrigerant, or reverse. This unique circular or rectangular coil consists of six ⅜" O D Bridgeport Admiralty tubes nestled inside a larger, 1⅜" O D Admiralty tube. The six smaller tubes are inserted into a straight length of larger tube and then coiled or bent on blocks of various radii. This fabricating method requires closely controlled physical properties of tube to avoid distortion. The length and number of coils—whatever their size—is subjected to a test of 1,000 lbs. pressure before being accepted for application.

Years ago, trouble was frequently experienced due to copper tube failure or excessive scaling caused by highly corrosive waters in certain localities. This failure was costly since,when it occurred, it was necessary to replace the entire condenser.

Bridgeport came up with the answer—Admiralty tubes. Since the switch, over 1,000 Typhoon heat pumps have gone into service without one instance of tube failure due to corrosion in sizes varying up to 1,000,000 BTU's.

Here again is an example of how *standard* Bridgeport alloys overcame *special* fabricating and corrosion problems. It's also an example of why it pays to take advantage of Bridgeport's outstanding metals know-how. Call in the Man from Bridgeport, today. There's a Sales Office near you. Or write to Dept. 5006.

BRIDGEPORT BRASS COMPANY

Bridgeport 2, Connecticut • Sales Offices in Principal Cities

Specialists in Metals from **A***luminum to* **Z***irconium*

TECHNICAL

Nuclear Processing Updated

PROCESS CHEMISTRY, Vol. 2. (SERIES III OF PROGRESS IN NUCLEAR ENERGY) Edited by F. R. Bruce, J. M. Fletcher and H. H. Hyman. Pergamon Press, Inc., New York. 579 pages. $17.50.

Here is the second in a series on chemical processing in the nuclear industry. The first volume is packed with information declassified for the 1955 Geneva Conference, while this latest volume reports the progress since 1955. It's a very complete exposition of chemical process information in the nuclear field.

Just as the chapter authors are recognized authorities in the fields they write about, the editors are equally authoritative: F. R. Bruce of Oak Ridge National Laboratory, H. H. Hyman of Argonne National Laboratory and J. M. Fletcher of Harwell.

Chapters on uranium and thorium ore processing and uranium hexafluoride production are particularly timely in view of recent industry development efforts. J. W. Ullman's chapter on the fuel cycle gives a complete summary of the factors effecting fuel cycle costs. Other chapters on solvent extraction, ion exchange and nuclear waste reprocessing give details of recently developed processes.—JAK.

The Political View

THE ATOM AND THE ENERGY REVOLUTION. By Norman Lansdell. Philosophical Library, Inc., New York. 200 pages. $6.

What will be the impact of atomic energy in the next fifty years? Norman Lansdale shows in his book, "The Atom and the Energy Revolution," how the development of atomic power may change the balance of world trade and the power industry's relation to the government.

Lansdale summarizes the cur-

BOOKSHELF

J. B. BACON

rent energy resources and demands, country by country, and intimates the political results of the race for power. One chapter in his book gives an up-to-date summary of atomic power development in each country, while another gives the details of the maze of political and industrial organizations in atomic energy.

Here is a book that will interest the engineer who wants to get the complete picture of the nuclear industry from a political standpoint. It is not written to enlighten the reader in nuclear technology. The brief chapter relating the principles of fission power is written with almost insulting simplicity.—JAK

BRIEFLY NOTED

ASTM STANDARDS ON SOAPS AND OTHER DETERGENTS. 256 *pp. American Society for Testing Materials.* 1916 *Race St., Philadelphia* 3, *Pa.* $3.50. Contains 40 standards, 11 of which are new, revised or have had their status recently changed.

JOURNAL OF APPLIED POLYMER SCIENCE. *Edited by Herman Mark, L. Bateman, J. H. Dillon, M. Morton and F. Patat. Interscience Publishers, Inc.,* 250 *Fifth Ave., New York* 1, *N. Y. Annual rate,* $35. Now being published bimonthly to serve scientists and engineers in fundamental knowledge and practical application.

MORE NEW BOOKS

AIR POLLUTION CONTROL. By W. L. Faith. Wiley. $8.50.

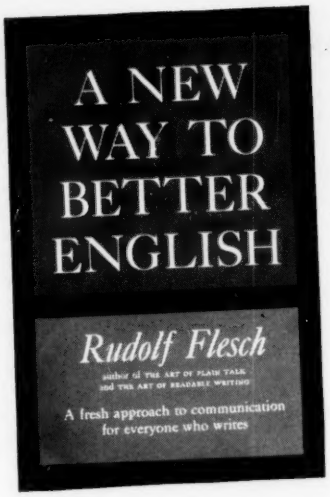
TECHNOLOGY IN AMERICAN WATER DEVELOPMENT. By Edward A. Ackerman and George O. G. Lof. Johns Hopkins. $10.

ANALYSIS OF STRAIGHT-LINE DATA. By Forman S. Acton. Wiley. $9.

THE NIMONIC ALLOYS. By W. Betteridge. St. Martin's Press. $15.

THE CHEMISTRY OF INDUSTRIAL TOXICOLOGY, 2nd ed. By Hervey B. Elkins. Wiley. $11.50.

LETTERS:



Con: Flesch and Evans

Sir:

It now appears that not by accident was the infinitive split in the title of my recent article on the control of steam-jet ejectors (Mar. 23, pp. 171-174). Perhaps your staff had already read the book by Mr. Flesch on which the article in your Apr. 20 issue (pp. 188-194) was based.

To think that your readers believe me guilty of this deed pains me greatly—me, who would never dream of treating so rudely the sacred foibles of our language!

One further comment: I hope that justifying the mediocre by its prevalence is an exercise of logic to be reserved for the exclusive use of Mr. Flesch. I cannot tell whether he does not appreciate, or simply does not prefer, the nuances of the written word.

GRAHAM B. KNIGHT
J. R. Minevitch & Associates
Boston, Mass.

► *The headline of Mr. Knight's article, for which we take complete responsibility, read: Five Ways to . . . AUTOMATICALLY CONTROL PRESSURE for Ejector Vacuum Systems.*—ED.

Sir:

Mr. Flesch's article in your Apr. 20 issue prompts me to retort: Let's not be brainwashed

PRO & CON

C. H. CHILTON

by Rudolph Flesch and Bergen Evans!

Basic English, with 800 words and little grammar, is the speech of two-year-olds; pidgin English, with even less of either, that of Polynesian natives. But neither of these languages fills the needs of our everyday adult world.

Writing should not be reduced to the crudity of speaking. It lacks the extra dimensions of modulation and tone; and misunderstandings cannot at once be caught and corrected. Flesch's "better" English, like some modern orchestral music, is a hollow, mechanistic imitation, discordant and off-beat. His path is one of relaxing ourselves into gelatinous nothingness.

For guides to clear and expressive—as well as natural—writing, I will still rely on such works as Funk and Lewis's "Thirty Days to a More Powerful Vocabulary" and Nicholson's "Dictionary of American-English Usage." Words are the medium of our thought, and a discriminating precision in using them is often the key to full understanding of a subject.

T. VERMEULEN
University of California
Berkeley, Calif.

Sir:

As an amateur writer, I'm glad to learn that it's now acceptable to split infinitives, permissible to dangle prepositions, and quite correct to holler, "It's me!" when surprised in the showerbath.

It's also nice to have a tabulation of the most common "social mistakes," though the items differ sharply with another listing I once saw under the same title. And if I'd been told about "executive" English 30 years ago, who knows, I might today be in the 91% tax bracket! Anyway, I'm glad to know what the trouble was.

But I agree only partly with Author Flesch when he exhorts his readers to use the "natural" language. What the language doctors seem generally to over-

PRO & CON . . .

look is variance in human nature; what is natural for one person may be ludicrous in another. There are pompous people as well as plain, folksy people. So what is more natural than grey-flannel jargon from Madison Avenue, double-talk from Washington, pompous expressions from the campus, and folksy talk from — yes, you guessed it—Author Flesch?

If this trend toward conformity to folksy, old-shoe English goes much further, we'll all catch fire in the same ball park.

CHAPLIN TYLER
E. I. du Pont de Nemours & Co.
Wilmington, Del.

A Better Way to File

Sir:

I suppose that many engineers, like myself, clip articles from your magazine and file them for future reference.

If you would provide a method whereby this material could be so arranged and filed that any specific item desired would be available without too much difficulty, this would be an added service to your readers.

Chemical Engineering could publish some type of decimal classification system for chemical engineers and use this system in the magazine by assigning classification numbers to articles. It would not be necessary to assign a classification number to each article—just to those which might be clipped and filed.

KENNETH R. SCHULTZ
Spencer Chemical Co.
Pittsburg, Kan.

Sir:

In your Apr. 21, 1958, issue, under the caption, "A Better Way to File" (p. 1), you promised a series of articles on a decimal classification system of filing chemical engineering knowledge. At that time you expected to publish the articles later in the year.

We have been unable to find them in any of your subsequent issues. I realize that this is a project of some magnitude and might very well take longer than originally anticipated. If the articles have been published, would you be good enough to give me the dates of the issues in which they appeared?

JAMES A. MARRS
American Potash & Chemical Corp.
Henderson, Nev.

Sir:

In your Apr. 21, 1958, issue you published an item on p. 1, "A Better Way to File." At that time you stated that a filing system would be published later in the year.

To date, the plan has not appeared. Anxiously awaiting for its publication, I would greatly appreciate your telling me how long it will be before it goes to press.

PAUL C. DOBE
Sewerage Commission
Milwaukee, Wis.

▶ *We did make such a promise, in all good faith. But alas, we counted our chickens too soon; our author ran into certain hurdles which have delayed his undertaking this job.*

Meanwhile, the clamor from chemical engineers for a filing system has reached the ears of the Standards Committee of the American Institute of Chemical Engineers. A new subcommittee has just been formed to consider the need for a standard classification system and to recommend how to develop one. If the institute undertakes to develop such a system, we would accomplish little by publishing a different and possibly conflicting system.

Of course, many worthy projects die in committee. We urge those of you who see the value of a standard classification system to write to AIChE, 25 W. 45th St., New York 36, N. Y., expressing your interest in this project. And we'd appreciate your sending us carbons of your letters.—ED.

READER SERVICE . . .

TECHNICAL

Contents of This Issue

Chemicals

Anhydrous Aluminum Chloride..... Information, including the range of screen sizes, bulk shipment data, & test samples of anhydrous aluminum chloride offered.
71 *Allied Chem., Solvay Process Div.

Borohydrides.....16 p. annotated bibliography, "The Borohydrides in Cellulose & Sugar Chemistry," provides background synopsis of 18 publications re cellulose, 15 re sugar.
166A Metal Hydrides Inc.

Butynediol.....40 p. booklet presents the physical and chemical properties of butynediol and discusses its industrial applications. Covers storage and handling too.
166B General Aniline & Film

Chemicals.....Peroxygen is a word used to indicate how oxygen can be tied into just about anything. Complete information about Peroxygen Chemicals is available.
59F *Becco Chemical Div., FMC

Chemicals.....Brochure on high purity cresylics is offered. This useful literature is complete with product descriptions, specifications, & suggested uses.
144 *Pitt-Consol Chem. Co.

Chemicals.....Samples & specification sheets of phthalic anhydride, maleic anhydride or fumaric acid are now available on request. Send for your copy.
123 *Pittsburgh Coke & Chemical Co.

Clay.....4 p. bulletin No. 402 covers the properties and application characteristics of a complete line of Attapulgus clay and activated bauxite for the oil industry.
166C Minerals & Chemicals

Colorants.....4 p. booklet describes line of Drycol dry colorants for all thermoplastics. Includes standard color key chart for polyethylene and polystyrene.
166D Gering Products, Inc.

* From advertisement, this issue

LITERATURE

E. M. FLYNN

Dicyclopentadienyliron.....2 p. describes characteristics and specifications of MC & B Ferrocene or dicyclopentadienyliron. Also lists references.
167A Matheson Co.

Ethoxylated Chemicals.....Newly revised booklet covers their chemical properties and widespread potential application as cationic or nonionic surfactants.
167B Armour Chemical Div.

Flake Caustic Soda.....Samples and technical data on four caustic soda flake is offered. Regular, Fine & Crystal sizes are especially firm & nondusting.
85 *Hooker Chemical Corp.

Lubricants.....4 p. bulletin 121 contains a Molykote lubricant selector chart to facilitate choice of proper lubricant for almost an extreme pressure lubrication job.
167C Alpha-Molykote Corp.

Lubricants.....Explosion-safe, fire-resistant lubrication for air compressors is covered in an illustrated 4 p. folder. Tabulation cover typical physical characteristics.
167D E. F. Houghton & Co.

Lubricants.....Book discusses organized lubrication from management's point of view. Also discusses methods that help raise production, extend parts life.
65 *Texaco, Inc.

Magnesium Oxide.....A test sample of low-iron, low-lime MgO in any of its three forms; powdered, pelletized or granular, is yours for the request.
97 *International Minerals & Chemical

Mortar.....Two 4 p. data sheets, 630 and 631, cover properties and application instruction, respectively, on Penntrowel, a resinous, thermosetting mortar for coating concrete.
167E Pennsalt Chemicals Corp.

Muriatic.....Data on the production, uses, properties and handling is contained in a 40 p. brochure. Twenty-six graphs and tables provide useful reference data.
167F Stauffer Chemical Co.

* From advertisement, this issue

Want to build up your files and keep them up-to-date? You can get any publication in this comprehensive guide — free — just for the asking.

It's easy — simply circle item's number on the Reader Service Postcard and mail. Replies will come directly from companies offering the literature.

LITERATURE . . .

Plastic.....Bulletin on Plastic Steel is now available. Easy to use as modeling clay...hardens to steel like strength in 2 hours...can be machined with regular tools.
L182 *Devcon Corp.

Plasticizers.....Properties and specifications of seven plasticizers recommended for nontoxic applications are described. Includes comparative performance data.
168A Monsanto Chemical Co.

Polyester Resins.....5 p. bulletin describes company's Laminac resins, liquid thermosetting polyesters, and properties which make them advantageous in reinforced plastics.
168B American Cyanamid Co.

Polyester Resins.....4 p. bulletin, "New Chemical- and Corrosion-Resistant Resin Uraloy 7416," shows how this resin with glass fiber stands steam, heat, caustic.
168C Interchemical Corp.

Rare Earths.....Data sheet covers yttrium, lanthanum, cerium, praseodymium, neodymium, samarium, gadolinium, terbium, dysprosium, holmium, erbium and ytterbium.
168D Nuclear Corp. of America

Reinforced Plastic.....8 p. "Designing with Reinforced Plastic," tabulates comparative properties of plastics, tells how to choose right resin-reinforcement combination.
168E Society of the Plastics Industry

Silicon Carbide.....Silicon carbide foam, a new high temperature material with excellent thermal insulating properties is described in 3 p. data sheet.
168F Carborundum Co.

Silicone Antifoams.....Two types; SAG 470 Emulsion for aqueous systems, SAG 47 Fluid for non-aqueous systems.
B193 *Union Carbide Corp., Silicones Div.

Skin Protectors.....Three new creams said to provide protection against any skin irritant commonly met in industry are described in 4 p. bulletin 0403-4.
168G Mine Safety Appliances

Sodium Borohydride.....Tech. bul. No. 550 covers the availability, the properties & the storage & handling. Also includes analysis & uses of sodium borohydride-SWS.
168H Metal Hydrides Inc.

Sodium Formate.....6 p. booklet describes buffering economies offered by sodium formate. Product specifications, typical properties and characteristics are covered.
168I Heyden Newport Chemical Corp.

Sodium Hydride.....The new 20-page brochure, "Sodium Hydride Dispersed In Oil," a manual covering properties, reactions, handling & safety is available.
73 *Metal Hydrides Inc.

Sodium Phosphate.....Revised technical bulletin and use reference guide cover company's many sodium phosphate products for soap & detergent manufacturer.
168J Monsanto Chemical Co.

Sodium & Potassium Borohydride.....A manual of techniques covering properties, reactions & handling & safety of sodium & potassium borohydride is now available.
168K Metal Hydrides Incorporated.

* From advertisement, this issue

Stabilized Sulfuric Anhydride.....A 28-page brochure includes a description of the physical & chemical properties of "Sulfan", correct procedures of handling, etc.
41a Allied Chem., General Chem. Div.

Sulfur Trioxide.....Brochure "Reactions of Sulfur Trioxide" covers reactions of SO_3 & its organic complexes with organic compounds to form sulfonates or sulfates.
41b *Allied Chem., General Chem. Div.

Urethanes.....7 p. bulletin, "Multrathane, Urethane Elastomer Potting Compounds," contains sections on polyester-diisocyanate systems and polyethey-diisocyanate.
169A Mobay Chemical Co.

Vinyl Acetate Monomer.....The monomer for use as an intermediate to prepare pharmaceuticals & fine organic compounds. Technical data is available.
57 *Celanese Corp. of America

Construction Materials

Alloys.....Full information on corrosion-resistant alloys, their properties, forms, the corrosives they will resist, contained in a 104-page book.
135 *Haynes Stellite Co.

Aluminum Conduit.....offers many special features such as light weight, ease in handling, corrosion resistance, and clean appearance.
22-23
***Aluminum Company of America**

Hard Carbide Alloys.....can be supplied as standard rectangular blanks, discs, rods, tubes, etc. Can be extruded, pressed, machined or ground . . . to precise tolerances.
166 *Kennametal Inc.

Hydrated Chromium Oxides.....are most stable of the green pigments. They are uneffected by acids, alkalis, vehicles, & solvents. Full technical data & samples offered.
150 *C. K. Williams & Co.

Protective Coatings.....4 p. brochure contains application and test data on a coating fur curing, sealing and dustproofing newly-poured concrete called Kure-N-Seal.
169B L. Sonneborn Sons

Protective Coating.....2 p. bulletin 64 describes application and performance of a coating called Fabrifilm for protecting surfaces during in-plant processing.
169C Turco Products Inc.

Protective Coatings.....Tygon Data Book contains complete application details plus helpful information on performance of Tygon Paint over a wide range of corrosives.
32 *U. S. Stoneware

Stainless Steel.....Tensile tests, X-ray diffraction studies, automation gaging, laboratory samplings, & other tests to assure quality. Data book offered.
152 *The Wallingford Steel Co.

Steel.....New Reference Book provides information about changes & improvements in materials, methods, etc. Describes & pictures several of the modern mfg. processes.
169D Wallingford Steel Co.

* From advertisement, this issue

LITERATURE . . .

Structures.....Complete information on the coordinated services plus the brochure CB&I Craftsmanship in Steel are now available on request. Send for your copy.
Cover *Chicago Bridge & Iron Co.

Wire Cloth.....A 94-page catalog & stock list gives the full range of wire cloth available, describes fabrication facilities & gives useful metallurgical data.
31 *Cambridge Wire Cloth Co.

Wire Cloth.....Latest literature covers details on woven wire cloth or fabricated wire cloth parts requirements, all widths, all meshes, all malleable metals.
170 *Newark Wire Cloth Co.

Electrical & Mechanical

Drives.....Complete details on the fractional hp. V-S Jr. are contained in Bulletin D-2507. This electric variable speed drive is available from ⅛ thru ¾ hp.
195 *Reliance Electric & Engineering

Electrical Insulating Materials..... GET-2929 describes in text, tables and pictures the characteristics and application range of electrical insulating materials.
170A General Electric

Engines and Power Units.....Two new catalogs cover G-226 and G-149 engines and power units. Design, engineering and performance capabilities. Illustrated.
170B Allis-Chalmers

Fixtures.....The Convertible vapor-tight series V-51 are available in a variety of hub sizes in pendent, ceiling, or bracket type fixtures for every kind of installation.
34 *Appleton Electric Co.

Motoreducers.....Comprehensive booklet describes the complete line of the manufacturer's All-Motor and Integral Motoreducers. Details on size and construction.
170C The Falk Corp.

Motors, Enclosed.....Designed to give extra protection against corrosive abrasive and explosive elements. Motors deliver full-rated hp under the toughest service conditions.
140 *Wagner Electric Corp.

Static Seal.....Newly developed for hydraulic and pneumatic systems, a line of static metallic seals combine infinite shelf life with sealing at —350 to 1,800 F. Bulletin.
170D Cadillac Gage Co.

Substations.....for any application, indoor or outdoor. With dry or liquid-filled transformers, large air breakers or molded case breakers, motor control units. Literature.
25 *Square D Company

Torque Wrench Adapters.....Illustrated bulletin outlines the Sensory Torque Wrench, the Basic Multi-Purpose Adapter Arm, & the Adapter Drive End Accessories.
170E P. A. Sturtevant Co.

Turbines.....YR turbines are designed for easy installation & service. Many key parts are interchangeable for various frame sizes. Descriptive bulletin H22-C.
75 *Elliott Company

* From advertisement, this issue

Handling & Packaging

Automatic Filling Scales.....Bulletin illustrates ten main types of automatic scales. Capability and specifications of each is discussed. Operational diagrams.
171A Thayer Scale Corp.

Conveyor Components.....Facts on the complete line of accessories are contained in Folder 2489. They can be installed on new or existing systems.
63 *Link-Belt

Feeder-Hopper.....unit is offered in two models; one for high capacity applications & one for maximum control. New Bul. 591 describes Amplitrol "package" in detail.
160 *Carrier Conveyor Corporation

Glass Packaging.....New booklet entitled "Imagination in Glass" provides information on a wide range of packaging problems handled by new styling and design center.
171B Hazel-Atlas Glass

Industrial Trucks.....Literature gives specifications for fork trucks, ram trucks, platform trucks and mobile cranes. Details company's special engineering service.
171C Elwell-Parker

Payloader.....The H-25 feature maneuverability & speed with 2,500 lb. carry capacity. Facts about the H-25 Payloader and other Payloader models is available.
26 *The Frank G. Hough Co.

Tank Trucks, Stainless steel.....offer excellent corrosion resistance. Further information on contaminant-free shipment of your finished products & raw materials available.
84 *Armco Stainless Steel.

Tool Truck.....is invaluable wherever tools or parts transport is needed. Upper panel section is partitioned for nuts, bolts, parts. Ample storage space throughout.
171 *Snap-On Tools Corp.

Tractor Shovel.....The 72 hp. 6 cylinder engine provides smooth power through matched torque converter & torque transmission. Handles 2500 lb. carry capacity. Details.
61 *Yale & Towne Mfg. Co.

Heating & Cooling

Electric Heaters.....Bulletin illustrates the complete line of Chromalox flexible and molded electric heaters. Sizes from postage stamp size to 2 x 125 ft.
171D Edwin L. Wiegand Co.

Heat Exchangers.....Pyrex modular shell & tube heat exchangers heat, cool, and condense corrosive fluids. Complete information contained in bulletin PE-33.
20-21c *Corning Glass Works

Heat Transfer.....An eight-page bulletin on the new Multi-Zone Platecoil heat transfer unit illustrates and discusses construction and application advantages.
171E Tranter Mfg., Inc.

* From advertisement, this issue

LITERATURE . . .

Kilns, Rotary.....Kiln shells are fabricated of quality steel plate. The main gear of a rotary kiln is made in halves & usually of cast steel. Bulletin #1115.
194 *Traylor Engr. & Mfg. Co.

Liquid Heater.....is economical to install & operate, can be applied to existing equipment as well as new construction. Bulletins contain complete information.
125 *Allis-Chalmers, Hydraulic Div.

Rotary Air Cooler.....Catalog A offers complete information on Pressing, Drying & Cooling Equipment for all your problems.
*Davenport Machine & Foundry Co.
T191

Steam Generators.....Package type & custom built units are available in a wide range of types, capacities & pressures to meet operating requirements. Bulletins 24A-BC.
117 *Henry Vogt Machine Co.

Steam Traps.....A 48-page book tells how to correctly size, install & maintain steam traps for any pressure, temperature or any load. Also catalog data on all types.
6 *Armstrong Machine Works

Steam Traps.....Five basic types of steam traps; Thermo-Dynamic, Thermostatic, Liquid Expansion, Float-Thermostatic, Camlift Bucket. Literature available.
14-15 *Sarco Company, Inc.

Sterilizing Ovens.....Precisely controlled, quick-acting ovens for special industrial processing applications are described in new literature. Three models.
172A Despatch Oven Co.

Instruments & Controls

Controls.....A complete line of controls. Design Manual 555 contains complete design data on all sizes of standard flexible shafts, geared joints, & terminals.
148 *Stow Mfg. Co.

Gauges.....Complete details on Tank Contents Gauges are available. All models feature large easy-to-read dials. Remote reading . . . no power required.
T192 *The Liquidometer Corp.

Instrumentation.....Electronic Consotrol is a counterpart of its world-famous pneumatic Consotrol line. For the full story on this process control, Bul. 21-10.
8-9 *The Foxboro Co.

Leverage System.....Controls processing or materials handling by weight. Literature on its application to filling, batching & check-weighing operations is available.
176 *Thayer Scale Corp.

Pressure and Vacuum Gages.....New catalog covers line of dial indicating and recording pressure and vacuum gages. Many dial sizes, materials and operating ranges.
172B Weksler Instrument

Viscometran.....Viscosity can be continuously process controlled with the Viscometran. Complete information.
*Brookfield Engineering Lab., Inc.
R181

* From advertisement, this issue

Pipe, Fittings, Valves

Connectors, Flexible.....MNH flexible connectors dampen vibration, compensate for misalignment, permit offset movement, & absorb expansion. ALLFLEX bulletin.
B191 *Allied Metal Hose Co.

Drainline, Glass.....Bulletin PE-30 contains complete information on Pyrex brand pipe for use in drainline systems. Glass handles wastes, particularly corrosive ones.
20-21d *Corning Glass Works

Expansion Joints.....Bulletin describes company's complete line of packless corrugated expansion joints. Convenient guide to expansion joint selection.
173A Zallea Bros.

Finned Tubes.....Catalog lists all sizes, alloys, heat transfer data, application data, etc. for many types of integrally finned tube. Tubes now have 13% increase in area.
173B Wolverine Tube

Flexible Metal Hose.....Full information on industrial applications of flexible metal hose and components is available in new company literature.
173C U.S. Flexible Tubing Co.

Forged Steel Unions.....New catalog covers the complete line of W-S unions. Detailed specification data on all types, sizes, materials and pressure ratings.
173D H. K. Porter Co.

Hose.....Teflon-lined hose available in larger diameters. Reinforced with Titeflex "zero-motion" braiding. Data sheets contain answers to your needs.
29 *Titeflex Inc.

Internal Insulating Systems.....Brochure covers details of manufacturer's internal insulating systems for piping carrying gases at elevated temperature, pressure.
173E Baldwin-Hill

Pipe.....High impact rubber-plastic. Most economical for average chemicals. Screw or solvent welded fittings. Valves ½ to 2". Bulletin 80A.
156f *American Hard Rubber Co.

Pipe.....Duplex aluminum is available in 4 sizes, 1½", 2", 2" & 4". Brochure contains details on joining, sizes, alloys & pressure ratings.
67 *Reynolds Metals Co.

Pipe Clamp.....for repairing corrosion leaks & splits in pipe lines. Massive malleable iron construction, full length hinge along one side; oversized plated bolts. Folders.
131 *M. B. Skinner Co.

Pipe. Glass.....Facts about Pyrex brand glass pipe or columns contained in Bul. PE-3. Complete manual on design, engineering & installation.
20-21a *Corning Glass Works

Pipe. PVC.....All-purpose rigid PVC in schedules 40, 80, & 120. ⅛ to 4". Threaded or socket-weld fittings. More information in Bulletin CE-56.
156c *American Hard Rubber Co.

* From advertisement, this issue

Pipe & Fittings.....Bulletin PF 1200 covers physical properties, chemical resistance and other general information on PVC Pipe, Threaded Fittings, & Socket Fittings.
T190 *Luzerne Rubber Co.

Strainers.....for efficient removal & disposal of suspended particles from raw or process water & other liquids. Bul. 500.1c & list of installations are available.
TL193 *S. P. Kinney Engineers, Inc.

Tubing, Stainless.....A wide range of materials & large diameters with walls as thin as .032". A 32-pg. booklet on technical data, grades & suggested applications is offered.
55 *Allegheny Ludlum Steel Corp.

Valve, All-Glass Y.....The new Bulletin PE-4 offers complete information on the all-glass Y-valve. Now available in 1½" and ½" sizes. Send for your copy.
20-21f *Corning Glass Works

Valve, Globe.....A completely new "Karbate" impervious graphite globe valve with many new design features is now available in the two inch size.
47 *National Carbon Co.

Valves.....Flocontrol with V-port disc insures proportional flow throughout the entire lift of the stem. Available in bronze & steel. Details on request.
4 *Manning, Maxwell & Moore, Inc.

Valves, Control.....for corrosive or non-corrosive flows . . . or other process flow conditions. Available in a wide range of types & sizes. New Catalog C800-1.
69 *Minneapolis-Honeywell

Valves, Drain.....cannot clog up. Designed so that in the closed position the piston or ram extends up into the tank. In open position, full flow assured. Catalog.
141 *Strahman Valves, Inc.

Valves, Gate.....Iron body gate valves are available in all-iron or bronze trimmed. Line included non-rising stem valves; also screwed & hub ends. Catalog.
95 *Crane Co.

Valves, Gate.....Rubber-lined type with special alloy working parts are made for pressures to 150 lbs. & temp to 150. Catalog No. 57 covers all types of gate valves.
167 *Darling Valve & Mfg. Co.

Valves, Gate.....Complete details & special features of the new bronze union bonnet gate valves are contained in the new illustrated circular which is offered.
18-19 *The Wm. Powell Co.

Valves, Safety-Relief.....offers simplicity in design, safety in operation. Detailed information for selection & sizing of all process safety-relief valves in Catalog FE-118.
172 *Farris Engineering Corp.

Valves, Safety Relief.....features a durable, two-ply stainless steel sealing bellows which isolates contaminants, or viscous fluids from parts.
*Manning, Maxwell & Moore, Inc.
80

Valves, Stainless Steel.....A new catalog outlines patterns you want, in a choice of alloys that satisfy the requirements of practically all corrosive services.
89 *Jenkins Bros.

* From advertisement, this issue

Process Equipment

Blenders, Rotary.....available in nine standard models with capacities to 900 cu. ft. Feature self-cleaning, dust-sealed drum. More information on Blenders in Bul. 080B.
L180 *Sturtevant Mill Co.

Centrifugal.....Illustrated details on Tolhurst centrifugals time & space-saving advantages is now available. Also data on the Batch-O-Matic.
*American Machine & Metals, Inc.
165

Centrifugals.....Roberts centrifugals feature reverse plowing, overload protection, & unbalanced-load protection. Descriptive Data Unit No. 2647.
174 *The Western States Mach. Co.

Centrifuge.....Illustrated bulletin No. 2606 covers Merco Equipment units. It includes applications & specifications of the different centrifuge models.
175A Dorr-Oliver Inc.

Chlorinators.....Details on the new V-notch chlorinators are now available on request. Feature maximum water value and use . . . even reuse. Send for your copy.
142b *Wallace & Tiernan Inc.

Dryer.....Complete information on vacuum chamber dryers is available on request. Special designs to solve your chemical processing problems.
39 *J. P. Devine Mfg. Co.

Drying, Blending, Sterilizing.....New bulletin describes the Controlled Dynamics method of combination drying, blending and sterilizing of moisture-sensitive materials.
175B Wilmot Castle Co.

Dust Collector.....The Microdyne is extremely compact . . . 1/10 to 1/90 the size of conventional wet collectors. Bulletin 317-11 is now available.
7 *Joy Mfg. Co.

Feeders, Scale.....Compact Merchen feeders are easy to install & operate in crowded areas. Can even be ceiling-hung. Information available.
142a *Wallace & Tiernan Inc.

Felt Filtration.....Performance characteristics and selection of proper felts for mechanical filtration of gases and liquids is the topic of Technical Data Sheet No. 15.
175C American Felt Co.

Filter.....The Horizontal Tilting Pan Vacuum Filter provides up to 560 sq. ft. of filter area. Complete information, layouts & estimates plus pilot-scale test data offered.
2 *Bird Machine Co.

Filter.....The new Fulflo rubber-lined steel filter is offered in 6 sizes, with from 6 to 60 Honeycomb Filter Tubes, for capacities up to 18,000-gph. Technical literature.
76 *Commercial Filter Corp.

Filters, Disc.....The Agitator-type disc filters are available in sizes to 9" diameter x 12 disc. Bulletin No. F9-B5 gives full particulars on this type.
175D Denver Equipment Co.

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LITERATURE . . .

Filter, Dust.....Complete specifications, typical equipment layouts, capacity & performance of the Reverse Jet Dust filter are contained in Bulletin F-75.
153 *The Day Company

Grinding Systems.....Air Swept grinding systems are available for a wide range of capacities and products. Full details are now available. Send for your copy.
R193 *Kennedy Van Saun

Mill, IMP.....is equipped with flash drying accessories for removing moisture while pulvering the material. Catalog 87 outlines all the features.
96 *Combustion Engineering, Inc.

Mills, Impact.....available in sizes to meet any requirement. The most efficient method of achieving particle size reduction by centrifugal force is covered in a bulletin.
176A Safety Industries, Entoleter Div.

Mills, Hammer.....feature extra heavy manganese steel liners & breaker plates, oversize shafts, massive parts & reinforcements. Catalog is available.
81 *Williams Patent Crusher

Mixers, Centrifugal.....A compact unit adaptable to continuous or batch system. The new principle of high speed mixing producing intimate dispersion outlined in Bul.
176B Safety Industries, Entoleter Div.

Mixing Machinery.....Bulletin No. CE-58 contains information on B-P equipment for the chemical process industries. Includes building mixing machinery.
77 *Baker Perkins

Plastic Exhaust Systems.....New folder describes how the use of exhaust systems made from thermoplastics can combat corrosion problems. Photos, charts and tables.
176C American Agile Corp.

Process Equipment.....Further information on Plate Heat Exchangers, Syncro-Matic Separators with TDM Control, and AC-VO "Nozzle-Matic" Centrifuge is available.
10-11a *The De Laval Separator Co.

Process Equipment.....Electrofining precipitation equipment helps to solve treating & separation problem in industry. Systems are closed, compact & automatic.
168 *Petrolite Corp., Petreco Div.

Pulverizer.....New bulletin describes the Jet Pulverizer, a machine for dry pulverizing of materials to micron-size powders. Mill diameters from 2 to 36 in. Eight sizes.
176D Jet Pulverizer Co.

Ribbon Blenders.....Construction features, dimensional and mechanical specifications for ribbon blenders and large-capacity mixers for corrosives covered in Bul. 800-159.
176E J. H. Day Co.

Valves, Rotary Vane Feeder.....Using close-up photographs, exploded views and engineering drawings. Bulltein 24-D provides details on rotary vane feeder valves.
176F Sprout, Waldron & Co.

Screens, Vibrating.....available in different sizes. Bulletin outlines the important new design & capacities for long life under rugged conditions.
176G Safety Industries, Entoleter Div.

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180A V. D. Anderson Co.

Spiral Rake Thickeners.....available in sizes to 150' diameter. Bulletin No. T5-B6 outlines the application of this equipment in the chemical process industries.
180B Denver Equipment Co.

Vacuum Equipment.....A 35-page catalog showing & describing many ways to improve your vacuum operations is now available on request. Catalog 1462.
L181 *C. H. Wheeler Mfg. Co.

Pumps, Blowers, Compressors

Air-Conditioning Systems.....Kathabar systems offer sterile air and frost-free cooling as special advantages to specifying engineers. Facts available.
161 *Surface Combustion Corp.

Air Filter.....AMERjets are available for handling any exhaust volume. complete information on the compact, factory-assembled AMERjet is contained in Bul 279.
78 *American Air Filter Co., Inc.

Compressor.....Class FE for vacuum service or pressures to 15,000 p.s.i.g. in sizes to 5,000 H.P. Built for direct motor mounting, flexible coupling or gear drive.
12-13 *Chicago Pneumatic Tool Co.

Exhausters.....Industrial Exhausters are available in numerous arrangements for many severe air & materials moving jobs. Details in Bulletin FI-110.
27 *Buffalo Forge Company

Induced-Draft Fans.....A complete line of induced-draft fans is described in Bulletin L-3. Fully dimensioned drawings and charts of ratings and specifications.
180C Lehigh Fan & Blower

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156a *American Hard Rubber Co.

Pump.....Bulletin 500-A contains a complete description & specifications on the new Auto-Pneumatic Microflo Pulsafeeder. Four models are available.
79 *Lapp Insulator Co., Inc.

Pump.....Type CK is available in 4", 6", 8", 10" & 12" sizes, and in semi-steel, ni-hard, cast steel or stainless alloys. Complete specifications offered.
143 *Morris Machine Works

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163 *F. J. Stokes Corp.

Pumps.....Specially-bonded, molded rubber-on-steel impellers & liners on the SRL Pumps last up to 15 times longer. Also available in acid-proof construction.
180D Denver Equipment Co.

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Pumps.....Three shaft & rotating parts assemblies provide for 41 sizes of 2 popular pumps. Details on this interchangeability are contained in bulletins 721.6 & 722.6.
147 *Goulds Pumps, Inc.

Pumps.....from thin solvents to thick paints. Bulletin Series 59SC outlines positive displacement pumps and what they can do for you. Send for your copy.
B192 *Viking Pump Co.

Pumps.....Revised Bul. 230 outlines horizontal duplex steam pumps for boiler feed, fuel oil pressure, oil transfer, general water service, etc. Includes sizes & capacities.
181A Warren Pumps, Inc.

Submersible Pumps.....Bulletin 203 illustrates and describes Layne horizontal in-line submersible pumps for booster service. Applications included.
181B Layne & Bowler, Inc.

Vibrating-Screen Enclosures.....Dust-tight enclosures for floor-mounted single-, double- and triple-deck Ripl-Flo vibrating screens are described in new leaflet.
181C Allis-Chalmers Mfg. Co.

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155 *Lukens Steel Co.

Corrosion.....“Solving Corrosion Problems in Industry” explains how bimetal tubes provide maximum protection handling two corrosives simultaneously.
181D Bridgeport Brass Co.

Electronic Weighing Systems.....Bulletin 4510 describes the SR-4 Electron Weighing Systems for tanks, bins, and hoppers. Contains design considerations, drawings, etc.
181E Baldwin-Lima-Hamilton Corp.

Engineering Service.....includes: a comprehensive survey of your facilities, installation supervision, periodic inspection, etc. Complete details offered.
59g *Becco Chemical Div., FMC

Equipment, Acid Proof.....The latest technical data bulletin describing Tantalum process equipment is offered. Equipment such as: heater coils, acid condensers, etc.
169 *Fansteel Metallurgical Corp.

Etching.....Tank immersion etching of printed circuits with Ammonium Persulfate is completely described in Booklet No. 99 which is now offered to you.
59d *Becco Chemical Div., FMC

Etching.....Booklet No. 102 features complete information on etching of printed circuits with Mercury Activated Persulfate. These facts are available to you.
59e *Becco Chemical Div., FMC

Fire Control Chart.....Two-color wall chart explains the three classes of fires and the approved portable extinguishers to be used on each. Available on request.
181F Walter Kidde & Co.

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Fire Extinguishers.....Folder contains a table that compares characteristics of various types of fire extinguishers. Effectiveness of extinguishing agents given.
182A Ansul Chemical Co.

Fire Extinguishers.....available in pressurized water for fires in ordinary combustibles, or anti-freeze loaded stream for fires in ordinary combustibles & flammable liquids.
173 *Walter Kidde & Co., Inc.

Fluorescent Penetrant Test Kit..... The new Zyglo test kit finds cracks, pores, leaks quickly. Bulletin outlines the kit & replacement materials.
182B *Magnaflux Corporation

Metal Treatments.....Complete information on improving properties of Copper and Brass surfaces is contained in Booklet No. 86 which is now available.
59b *Becco Chemical Div., FMC

Metal Treatments.....Booklets No. 39 and 51 completely outline the surface treatment of metals with Peroxygen Compounds. Now available on request.
59a *Becco Chemical Div., FMC

Paddle Etching.....Booklet No. 97 gives complete details on paddle etching of printed circuits with Ammonium Persulfate. It cleans fine, metal resists retarnishing.
59c *Becco Chemical Div., FMC

Plant Security.....Cost-saving plant security services for the process industries are reviewed in a new 16-page brochure. Thumbnails major areas of plant security work.
182C Pinkerton

Pastic Piping Systems.....Handbook is available. Covers valves mfg. from a variety of plastic materials, for a wide range of corrosive environments, temp. & pressures.
R180F *Chemtrol

Preventive Maintenance Products..... Proposal covers preventive maintenance products and services designed specifically for petroleum refineries. Coatings, cleaners, etc.
182D Xzit Chemical Co.

Research Facilities.....Complete detailed information about Waukesha's foundry and metallurgical research facilities are now available to you on request.
133 *Waukesha Foundry Co.

Screen Area Estimation.....Folder tells how to estimate screen area requirements in seven steps. Sample problem and solution. Also describes screening equipment.
182E Overstrom & Sons, Inc.

Splash Goggle.....The new A0711 & the established A0710 offer positive protection against chemical splashes. All parts are replaceable . . . 050" thick plastic lens.
9P *American Optical Co.

Tank Cleaning.....Details about tank cleaning equipment including the interior tank cleaning unit, model 531. Also details of cleaning methods for the chemical industry.
162 *Oakite Products, Inc.

Water Demineralizers.....available in two-bed, four-bed, & mixed-bed types. All types are covered in detail in a 20-page Catalog 127A. Barnstead Still & Demineralizer Co.
182F

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CLASSIFIED . . .

EMPLOYMENT OPPORTUNITIES

CE's nation-wide coverage brings you tips and information on current opportunities in job functions throughout the chemical process industries.

▶ **Coverage** — National Executive, management, engineering, technical, sales, office, skilled. Positions vacant, positions wanted, civil service, selling opportunities, employment agencies and services, labor bureaus.

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▶ **Closing Date**—June 29 issue closes June 5th. Send new ads to Chemical Engineering, P. O. Box 12, New York 36, N. Y.

ALCO PRODUCTS NEEDS

KEY PERSONNEL

FOR NUCLEAR POWER ENGINEERING DEPT.

REPORT DIRECTLY TO THE MANAGER

HEAD REACTOR ENGINEER

Supervises section responsible for reactor analysis, reactor experiments, thermal and hydraulics, mechanical core design and mathematics.

Advanced Technical Degree required. Ph.D. desirable. Several years experience in Nuclear Reactor Science and Engineering necessary, plus experience in technical administration.

CHIEF PROJECT ENGINEER

Administers and executes all projects in accordance with approved schedules and prepares and submits proposals.

Establishes and maintains effective controls and schedules on all projects.

Advanced degree desirable. Must have several years of direct line supervisory experience of engineering projects—preferably nuclear.

HEAD PLANT SYSTEMS ENGINEER

Supervises plant design engineering for the application of nuclear energy. Responsible for materials technology, including radio-chemistry and chemical engineering.

Advanced Technical Degree desirable. Several years of plant design experience necessary. Nuclear experience desirable.

Please send complete resume in confidence to: G. Y. Taylor, Administrative Services

ALCO PRODUCTS
INCORPORATED
Schenectady 5, New York

CLASSIFIED . . .

EQUIPMENT SEARCHLIGHT

CE's Searchlight spots the big bargains in used, resale and rental equipment. Check this issue's listings—most complete in the field—for items you need now.

▶ **Coverage** — National Equipment and facilities—used, resale and rental—for the process industries. For sale, wanted, for rent.

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1—Standard Steel 8' x 50' Rotary Dryer, welded const. Completely equipped.

45—Beach Russ High Vacuum Pumps, type RP, Series 100, Class D, 100 CFM, 5 HP motor.

4—Oliver 8' x 14' Rotary Continuous Vacuum Filters. Steel drum.

2—Raymond 4 Roller High Side Mills, Double Cone Sep. Cyclone, Fans, and Dust Collector.

1—5' x 2'6" Jacketed Ball Mill, with 25 HP, expl. proof motor.

3—Hamilton 100 gal S.S. jacketed Agitated Kettles, 90 PSI.

For immediate quote, wire or phone collect—GA 1-1380

ME MACHINERY AND EQUIPMENT COMPANY
123 Townsend St. · San Francisco 7, California

MODERN REBUILT MACHINERY — **UNION** Rebuilt Machinery Established 1912

FILLING LINE: 4 Piston Filler. Pneumatic Scale High Speed Capper and Labeler with interconnecting Conveyors.

Pneumatic Scale High Speed Automatic Cartoning Line with Feeder, Bottom Sealer, Top Sealer, Wax Liner, Interconnecting conveyors.

Jones Model CMV highly flexible Automatic Cartoner.

Standard Knapp, A-B-C and Ferguson Case Sealers.

WRAPPERS: Package Machinery, Hayssen, Battle Creek, Scandia, Wrap-King—all sizes and models.

Colton Model 140 Single Head S.S. Tube Filler. Stokes & Smith Model DD-2 Rotary Tablet Machine.

Werner & Pfleiderer 3,000 gal and 3,500 gal. Jacketed Double Arm Mixers.

Baker Perkins, Day, W & P Heavy Duty Mixers, 12 to 150 gal. caps.

Stokes & Smith Model G1, G2, G4, HG84, HG87 and HG88 Auger Powder Fillers.

Mikro Pulverizers, ISH, 2TH, 3TH and 4TH.

Fitzpatrick Stainless Steel Cominuters.

Complete Details and Quotations Available on Request

WRITE, WIRE, PHONE COLLECT

UNION STANDARD EQUIPMENT CO.

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167 North May Street Chicago 7, Ill. SEely 3-7845

MILLS—Hammer—00 Sturtevant 10 HP, AKB Wms. 25 HP, 3W Mikro 30 HP, #2 Gruendler Supermaster 40 HP, #50 Raymond S/S Imp, AKBX Wms. 50 HP, 30 NF Wms. 100 HP, 36 x 52 Jeffrey 125 HP, SXT 14 Penna. 350 HP

MILLS—Colloid—1½" US 7½ HP, 2" B&S 20 HP, PA Robinson 5 HP, Sprout Waldron 2—40 HP motors

MILLS—Hardinge—Conical—4½ x 16 (10 HP) pebble, 4½ x 24 (25 HP) ball, 6' x 36" (60 HP) ball, 7' x 22" (75 HP) pebble, 8' x 36" (125 HP) ball, 8' x 48" (175 HP) ball, 10' x 48" (350 HP) ball

BIN—70 cu. yd. capacity Butler w/7 x 12 Bucket eelvator, weigh hopper

CONVEYORS—18" x 16' Farquar troughing, 18" x 34' apron, 18" x 37' trough, Bucket elevators to your specs.

PACKERS—St. Regis 100LS (unused), 105FV w/scales, Pneumatic Scale Capper.

AUTOCLAVES—35 Gal. S/S jacketed, 150 Gal. steel jacketed/agitated

DRYERS—12' x 24' x 90" truck/tray, Steam—24" x 22', 33" x 18', 36" x 24', 44" x 25', 4' x 40', 5' x 40', 9' x 30' Rotary

YOUR BEST REBUILT MACHINERY SOURCE

LAWLER COMPANY

Durham Ave. Liberty 9-0245 Metuchen, N. J.

Expanding? Relocating?

FOR SALE *READY TO OCCUPY*

Prime

INDUSTRIAL PLANT

CAMDEN, N. J. ● 28 ACRES 350,000 SQ. FT.

8 MAIN 1-STORY BUILDINGS
Steel & Brick ● Unrestricted

plus add'l auxiliary property, including overhead cranes, 10 to 120 tons.

880'Lx133'Wx46'H
800'Lx108'Wx40'H
540'Lx108'Wx40'H
475'Lx 90'Wx33'H
370'Lx 45'Wx50'H
120'Lx 60'Wx83'H

- Steam & Electric Power
- Plentiful Water and Sewage
- RR Siding
- Parking
- Good Labor Supply
- Low Insurance

WILL CONSIDER PARTICIPATION

CAMDEN FORGE CO.
P.O. Box 269, Hoboken, N. J.
New York Phone: BA 7-0600

FOR SALE

COMPLETE CHEMICAL OR OIL BLENDING PLANT

In Chicago with over 500,000 gal. cap. storage tanks. Site 221' x 554' with the following bldgs: 2 story office and storage bldg., large truck repair shop, boiler & pump house, oil blending bldg. and storage bldg., all brick and in good repair. Direct A. T. & S. F. spur on grade level. For full details write to: Real Estate Dept., Cities Service Oil Co.

CITIES SERVICE OIL CO.
20 N. Wacker Drive, Chicago 6, Illinois
ANDOVER 3-0300

WANTED

SURPLUS EQUIPMENT
SINGLE ITEMS OR ENTIRE PLANTS

FOR SALE

1—Eimco 8' x 10' Drum Filter
1—Eimco 4" dia x 8" lg Roll, Vacuum Rotary Filter Press
1—Stokes Model R Tablet Press
2—Colton Model 5½ T Tablet Presses
1—Rotex Sifter, 21" x 41"
3—Baker-Perkins 200 gal wc Mixers
1—Baker-Perkins 7 gal wc Mixer
Stainless Steel Kettles 20 to 200 gal. In Stock

AARON EQUIPMENT CO. ALL PHONES GLadstone 1-1500
9370 Byron St., Schiller Park, Ill.

FOR SALE

ABBE JAR ROLLING MILL

Double Tier—4 Jars—No. 2
Jars Are Stainless Steel
Mill Is Almost *New*

GLOBE TRADING COMPANY
1815 Franklin St. Detroit 7, Mich.
Woodward 1-8277

LIQUIDATION
AT THE
ESSO REFINERY
BALTIMORE, MD.

CENTRIFUGAL BLOWERS
41000CFM 28psia 3000HP Motor
22500CFM 15psia 2000HP Motor
6460CFM 148psia 2000HP Motor

20 TOWERS from 28'6" to 16' Dia., 20' to 145' high up to 300 psi

HEAT EXCHANGERS
Admiralty & Steel
100 to 7500 sq. ft.

50 PRESSURE VESSELS from 2' x 4' to 12' x 50', Pressures up to 350 psi

5—Clark 500 H.P. RA5 Gas Engine Driven COMPRESSORS—1138 CFM

125 CENTRIFUGAL PUMPS 70 to 1200 GPM, 17 to 910' head X.P. Motor & Turbine Driven

X.P. Motors & Starters
Structural Steel
Pipe, Valves and Fittings.

1500 Recorders, Controllers, Transmitters, Receivers, Rotometers, Gauges, etc.

Most Equipment New Since 1954
Your inspection invited—representatives on premises
Write—Wire—Phone for Complete Information
Site Office—Boston & Haven Sts., P. O. Box 5203, Baltimore 24, Md.

SELECTED STOCK ITEMS

15—ROTARY KILNS, Dryers, Coolers, 11'x155'; 8'x125'; 8'x100'; 8'8"x70'; 8'x50'; 7'x60'; 5'x24'; 4'x25'; 2'x30'.
2—STEAM TUBE DRYERS 6'x50' & 6'x25'.
1—50 gal. S.S. Jktd., Agit., Reactor.
1—GAYCO 14' Air Separator.
3—SWENSON-WALKER 24"x20' double spiral, jacketed Crystallizers, 2 HP.
2—STOKES DDS-2 Tablet Presses.
3—ROTO LOUVRE DRYERS Link Belt steel 502-16, 705-24; stainless 604-24.
4—316 STAINLESS STEEL Condensers 315 sq. ft., 156—1"x8' tubes.
10—TYLER-HUMMER Screens, 4'x6'; 4'x8'.
1—10,000 gal. Propane Tank 200 PSI.
8—EVAPORATORS, 500 to 15,000 sq. ft.
1—PFAUDLER 750 gal., glass lined, jacketed, agitated Reactor, 15 HP motor.
1—PFAUDLER 200 gal., G.L., jktd. agit.
1—COLUMN nickel clad 6'x27', 200 PSI.
1—REACTOR 750 gal. jkt. 300 PSI.
1—COLUMN 72"x30' Type 347 Stainless Steel, 20 bubblecap trays.
1—B. & J. #1½ Rotary Cutter 30 HP XP.
8—JEFFREY Hammer Mills, 15"x8"; 20"x12"; 24"x18" motor driven.

2—20 TON/DAY CHEMICO SULPHURIC ACID CONTACT PLANTS

5—CUPRO-NICKEL Heat Exchangers; 177; 346; 1035; 2330; 5200 sq. ft.
25—STEEL Heat Exchangers; 189; 880; 1042; 2060; 3900; 4420 sq. ft.
1—INDUSTRIAL Type SS-2 stainless Pressure Leaf Filter, 195 sq. ft.
3—SWEETLAND #10, #12 Pressure Filters, Stainless and steel leaves.
18—SHRIVER, SPERRY 12" to 42" steel, aluminum, wood Filter Presses.
3—RAYMOND 5 Roll low-side Mills.
1—RAYMOND 30" dbl. Whizzer Separator.
1—HARDINGE 8'x30" Conical Ball Mill.
3—TOLHURST 40" S.S. Centrifugals, Susp.
2—FLETCHER 40" Steel Centrifugals, Susp.
1—FLETCHER Whirlwind 48" Centrifugal.
1—FLETCHER 30" stainless Centrifugal, Susp., perforated basket, vaportite.
2—OLIVER 5'3"x3' Precoat Filters 316 stainless steel vaportite.
2—SHARPLES C-20 S.S. Super-D-Hydrators.
2—SHARPLES PN-14 Super-D-Canters S.S.
4—KOMAREK-GREAVES 27"x23" Briquetting Presses, Feeders & 75 HP motors.

HEAT & POWER CO., Inc.
New York Office—60 East 42nd Street, New York 17, N. Y.
Tulsa Office—306 Thompson Bldg., Tulsa 3, Okla.

NEW STAINLESS STEEL
COILS

Twelve Coils, 1½ inch schedule 40 LPS (1,900 OD x 145 wall) type 316 seamless pipe, 16 turns with type 316 plate flanges on ends, overall measurements diameter 17½ inches, height 72 inches, pipe manufactured by Allegheny Ludlum Corporation. F.O.B. our yard.....$200.00 ea.

Two Struther Wells Coolers, Heads Tubes & Tube Sheets Nickel, Baffles and shell material carbon steel, shell size 12 inch diameter, 14 feet long with 4 inch nominal connections, 88 tubes in each cooler, ID diameter ⅝ inch, type nickel seamless A. F.O.B. our yard, one cooler, $2500.00; both units, $4750.00. These units are used and in A-1 condition. Built for 50 pound working pressure.

Powder Gauging Machine (Multicheck instrument) for checking cross section of Mark 18, 19, 21 and 22 grain. Mfg. by Sheffield Corporation. Model #ME 1893. F.O.B. our yard...$2,500.00 This Unit Has Never Been Used.

Powder Cutting Machine with conveyor and pusher bar, serial number 27056B. Mfg. by Ex-Cell-O Corp. This unit has never been used. F.O.B. our Yard $2,500.00

Towmotor Forklift Truck, Model LT-56, 6000# Capacity. F.O.B. our yard.....$1,750.00

ABOVE QUOTATIONS ARE SUBJECT TO PRIOR SALE

PROGRESS IRON & STEEL CO.
Yard 11th & Locust - P. O. Box 447
JEFFERSONVILLE, INDIANA
Telephone - BU 3-7374

Dryers, Kilns, Centrifugals, Filters, Kettles, Tanks, Grinders, Crushers, Mixers, Screens, Tablet Machines, etc. Hydraulic, Plastic and Rubber Machinery. Send for bulletins.

STEIN EQUIPMENT CO.
107—8th STREET BROOKLYN 15, N. Y.
Sterling 8-1944

BUY ON TERMS!

S. S. SIGMA MIXER

Readco 25 Gal. S. S. Sigma Mixer. Jacketed, Vacuum Cover, power tilting.

ME MACHINERY AND EQUIPMENT CO.
123 Townsend St. · San Francisco 7, Calif.

WANTED
#2 SIMPSON MULLER
NO SUBSTITUTES.
W-1662, Chemical Engineering Class. Adv. Div. P.O. Box 12, N. Y. 36, N. Y.

"SEARCHLIGHT" Can Help You!

When you want to buy or sell used or surplus new equipment and/or accessories, or have other business wants—advertise them in the SEARCHLIGHT SECTION for quick, profitable results!

READER SERVICE . . .

INDEX OF

Month after month you'll find industry's most progressive firms among our ad pages.

Use this index to keep in touch with what they're offering that'll help you in your job.

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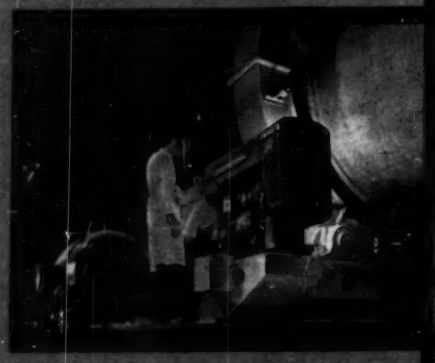
ADVERTISERS . . .

ADVERTISERS INDEX

precision engineered kilns

Traylor-made

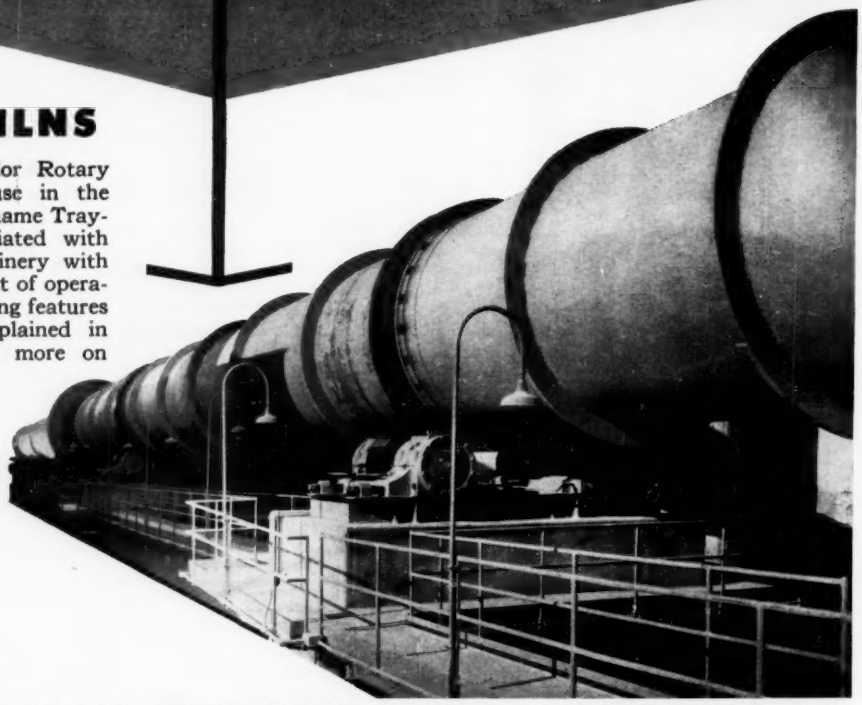


Auxiliary drive on a 7'-0" dia. x 250'-0" Rotary Kiln in a paper mill.

Plant view of a 9'-6" dia. x 250'-0" Rotary Kiln in a portland cement plant.

ROTARY KILNS

Many hundreds of Traylor Rotary Kilns are in constant use in the processing industry. The name Traylor has long been associated with rugged, dependable machinery with high efficiency and low cost of operation. The many outstanding features of Traylor Kilns are explained in Bulletin No. 1115. For more on Traylor, write today!



GYRATORY CRUSHERS • JAW CRUSHERS
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ROTARY KILNS • BALL MILLS • APRON FEEDERS

TRAYLOR ENGINEERING & MANUFACTURING COMPANY

1160 MILL ST., ALLENTOWN, PA.

Sales Offices: New York — Chicago — San Francisco

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INTRODUCING AN ALL ELECTRIC, VARIABLE SPEED DRIVE FOR UNDER $220.* THE FRACTIONAL hp. V★S Jr.

Now you can gain the efficiency of stepless speed changes for smaller machines. The new fractional V★S Jr. puts complete machine control at your operator's fingertips, for less than $220.*

The fractional V★S Jr. will vary drive motors speeds from 215 thru 1725 rpm. Speeds can be changed through this 8:1 range by a simple turn of the selector dial. Speed changes can be made while the machine is operating or pre-selected before starting.

This packaged drive provides start, stop and stepless speed changes from in-plant a-c. power. Jog, reverse, and braking functions are available for more flexibility. The fractional V★S Jr. is available from ⅛ thru ¾ hp. in all enclosures with standard or gearmotor, and is a new addition to the integral V★S Jr. line, 1 thru 4 hp.

For complete details contact your local Reliance Representative or write for Bulletin D-2507.

*⅛ hp. drive complete with motor, controls, and operators panel.

Product of the Reliance Electric and Engineering Company, manufacturers of a-c. motors, Master Gearmotors, V★S Drives, Super "T" D-c. Motors, generators, controls and engineered drive systems. D-1624

RELIANCE ELECTRIC AND ENGINEERING CO.

DEPT. 136A, CLEVELAND 17, OHIO
Canadian Division: Toronto, Ontario
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MASTER

REEVES

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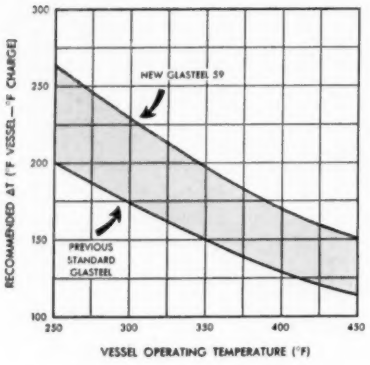
FLUIDICS

. . . is a new PFAUDLER PERMUTIT program providing a modern, imaginative approach—plus the specialized materials and equipment—for handling and processing more profitably the liquids and gases which are the lifeblood of our manufacturing economy.

FLUIDICS AT WORK

More thermal shock data on new Glasteel 59



We glassed the outside of two 2-inch steel pipes, one with Glasteel 59 and one with the best previous material, No. 53 Glass.

Then we heated both to 525° F. and quenched them quickly in a 70° F. water bath. The picture above shows what happened. With Glasteel 59 not a bit of damage . . . in spite of a 455° F. instantaneous thermal shock.

In other tests we heated Glasteel 59 to 600° F. and gave it a 530° F. shock and then to 625° F. for a startling 555° F. shock. There still was no sign of cracking or crazing or other damage on the sample pipe.

Naturally we do not recommend such severe treatment for your glassed-steel equipment; but we do recommend Glasteel 59 as offering the greatest protection against thermal shock damage—a full 30% increase over our previous best grade, as shown in the chart.

In addition to improved thermal shock resistance, Glasteel 59 also gives 20% better abrasion resistance and extended service life. For more information on this new material, write to our Pfaudler Division, Dept. CEB-69, Rochester 3, New York.

Pfaudler Permutit is observing its 75th anniversary. The company has manufacturing plants in Germany (Pfaudler-Werke A.G.), Great Britain (Enamelled Metal Products Corp. Ltd.), Canada (Ideal Welding Co. Ltd.), Mexico (Arteacero-Pfaudler, S. A.), and Japan (Shinko-Pfaudler Co., Ltd.), and four plants in the U.S. Sales Offices and representatives in leading cities throughout the free world.

PFAUDLER PERMUTIT INC.

SPECIALISTS IN FLUIDICS . . . THE SCIENCE OF FLUID PROCESSES